Examining the Effect of Navigational Redesign on End User Experiences

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Submitted by: Samantha Cooper

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Abstract

This project presents a user-centred design approach to the redevelopment of an application used to prepare data for a Customer Relationship Management system. A new system could potentially take minutes to support tasks that currently take hours. With an aim to improve the navigational efficiency through the user interface this project conducts background research, followed by requirements analysis and design and development. Finally an empirical evaluation is used to measure the success of the new interface by completing a comparative evaluation.

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Chapter 1

Introduction

The motivation for this project originated from an industrial placement year within a CRM project team at Eli Lilly & Company. Lilly is a global pharmaceutical company; their products treat cancer, diabetes, depression, schizophrenia and many other conditions.

During the development of a global Customer Relationship Management (CRM) solution, the design of the tools to support the user tasks were not considered beforehand. As a consequence, they were implemented in the quickest way possible without any regards for user needs. One particular system written in Microsoft Access was very poorly designed leading to a vast number of usability problems. The system failed to support the task in the same way as the initial solution and consequently led to a negative transfer of existing user knowledge. This in turn caused a great deal of user frustration with some users abandoning the system and resorting to completing the task manually.

The CRM system named 'OneLilly' was deployed to three countries in May 2007. The system to be redesigned is used for the preparation of data to be loaded into OneLilly and will be scoped such that the tool will be used by the UK team, only. The system generates 'targeting data' this is information that will define which healthcare professionals a particular sales representative will visit, the number of visits that should be made, and finally the sales quota they are aiming to achieve. The role of the system is to generate and output a combined objectives file to be sent to OneLilly using data from a variety of sources, including input directly from a user.

1.1 Aim

With users as design partners, the aim of this project is to evaluate and redevelop the OneLilly targeting application with particular attention to improving the navigational efficiency through the user interface. The research aim of the project will cover an investigation into how navigational design can influence user experiences.

1.2 Objectives

The key objectives of the project include:

- Complete a literature review to gain a foundation of knowledge in the relevant domain including usability standards, participatory design methodologies and navigation design considerations.
- Complete an empirical evaluation of the existing tool

- Engage sample users from the UK CRM team at Eli Lilly to identify their individual requirements and recruit them to the design team
- Undertake iterative user-centred design
- Iteratively develop and evaluate a new usable OneLilly targeting system
- Comparatively evaluate new system against the existing system using appropriate usability matrices and methodologies
- Complete a project overview to summarise and draw conclusions

The next chapter will investigate the existing literature within the scope of the project.

Chapter 2

Literature Survey

The user interface is the interactive part of a system that is used by the human. It is the means by which users give commands to control its operation, input data and respond to the output. In principle, it is relatively simple to create a user interface but it is rather more difficult to develop one that combines usability with usefulness and pleasure to use.

Preece et al [2] states that designing usable interactive products requires considering who is going to be using them, how they are going to be used, and where they are going to be used. She states that there are four basic activities of interaction design.

1. Identifying needs and establishing requirements for the user experience
2. Developing alternative designs that meet those requirements
3. Building interactive versions of the designs so that they can be communicated and assessed
4. Evaluating what is being built throughout the process and the user experience it offers

Evaluating what has been done is the main focus of interaction design. The main focus is to ensure that the product is usable and this is addressed through a user-centred approach which considered users throughout.

As described in the introduction chapter the project aim is to redevelop the OneLilly targeting application to more effectively support the user. With an aim to provide greater navigational support it will be hoped productivity can also be increased.

With this aim in mind this chapter will be used to gain a background understanding of the key factors, principles and methodologies in user interface design and development using a user-centred approach. The chapter will begin with a summary and discussion of human computer interaction (HCI) principles and the design considerations needed to support these principles. It will then move onto discuss navigation, user support and information presentation. The chapter will conclude by discussing user-centred design tasks and usability evaluation.

This chapter will also highlight some of the current research impacting navigation design decisions. This will include the field of information foraging theory and its related concepts such as information scent and latent semantic analysis.

2.1 Introduction to HCI

With the vast increase in use of PC's in the early 1980s, new usability challenges emerged and became more salient. Users consisted of cognitive scientists, psychologists, sociologists and philosophers; they were interested in how people solve problems and learn new things. This new area of shared interest between computer science and cognitive science is called Human Computer Interaction (HCI) [3].

"Human-computer interaction is the study of the relationships which exist between human users and the computer systems they use in the performance of their various tasks"[10].

A long term goal of HCI is to minimize the barrier between the human's cognitive model of what they want to accomplish and the computers support for the user's task. This means that HCI is concerned with providing an understanding of both the user and the computer system in an effort to make the interaction between the two easier and more satisfying. However the emphasis should always be on the user. The interest is in how the human user uses the computer as a tool to perform their desired task and in order to accomplish this task the user has to communicate with the computer.

To enable a successful interaction the product must be usable. The term usability has many different definitions; the Oxford English dictionary defines it as:

"The effectiveness, efficiency, and satisfaction with which users can achieve tasks in a particular environment of a product. High usability means a system is: easy to learn and remember; efficient, visually pleasing and fun to use; and quick to recover from errors".

Nielson [9] defines usability by five quality components:

1. **Learnability** - how easy is it for users to complete basic tasks the first time they use the system?
2. **Efficiency** – once users know the system how quickly can they perform tasks?
3. **Memorability** – when users return to using a system after a period of time how easily can they establish proficiency?
4. **Errors** – How many errors do the users make? Are the severe and can they easily recover from them?
5. **Satisfaction** – How pleasant is the system to use?

Nielson also discusses *utility* which refers to the design functionality, does it do what the users need? Usability and utility are equally important, it does not matter if something is easy to do if it is not what the user wants, just as it is no good having a system that could perform the right tasks but the user cannot make it happen because the user interface is too difficult to use. Ben Shneiderman [8] makes the same point by stating that usability is about understanding, stating and serving users needs. Since the needs are the requirements that shape tool they will determine the utility.

This is stressing the fact that for a system to be usable it must perform exactly what the user desires. This project is focused on improving the users' experience and therefore ensuring that the system enables the user to perform exactly what they need to. As detailed by Preece et al [2] the best way to accomplish this is by taking a user-centred approach to development, "this means the users concerns direct the development rather than technical concerns''.

To understand users it is necessary to understand processes, capabilities and predictions that users might bring to the tasks they perform. This will involve an understanding and knowledge of cognition.

The interface is the intermediate component between the user and the computer system; it reflects the system model to its users and translates their intentions into appropriate system activity. A user develops an understanding of how the system works and forms a model known as the mental model. This model is developed during the interaction and will then form the basis of future interactions with the system, the more someone learns about a system and how it functions the more their mental model develops. The term cognitive model is proffered, since it implies cognition which is more representative of the process involved [15].

2.2 What is cognition?

The term cognition refers to a facility for the human like processing of information; it involves cognitive processes like thinking, learning, remembering and decision-making. Norman distinguishes between two general modes:

Experimental is a state of mind of which we perceive, act or react to events around us effectively, for example driving a car.

Reflective involves thinking, comparing and decision making; this is what leads onto new ideas and creativity.

However it is clear that the experimental mode still requires comparing and decision making but this is just achieved automatically without us always realising. For instance in driving a car your actions will include things like deciding on when to change gear and comparing other drivers speed with your own.

According to Preece, both of these will require different technological support [2].

There has been research into the evolution of cognitive modelling for understanding and predicting user-behaviour in a computer system. One example of a cognitive model is to consider the theory of an action; this is how the user interacts in terms of their goals and what they need to do to achieve them. Norman's execution-evaluation cycle is the most influential in HCI. The cycle can be divided into two major phases, execution and evaluation. These are subdivided and form seven stages:

1. Establishing the goal
2. Forming the intention
3. Specifying the action sequence
4. Executing the action
5. Perceiving the system state
6. Interpreting the system state
7. Evaluating the system state with respect to the goals and intentions

The theory proposes that the stages take place sequentially but in reality activity would not proceed in such an orderly sequential manner, some stages could be missed, repeated or completed in a different order. As a model, it is an approximation of what might happen and could aid designers to think how best to design an interface to enable users to monitor their actions [2].

Norman uses this model to demonstrate why some interfaces cause problems to their users, he describes the terms:

- *Gulfs of execution* this is the difference between what the user wants to do and whether the interface allows them to. If there is no difference the interaction will be effective, the interface should therefore aim to reduce this *gulf.*
- *Gulf of evaluation* is the distance between the physical presentation of the system state and the expectation of the user, if the user can evaluate the presentation to form their goal the *gulf* is small. The more effort required the less effective the interaction is.

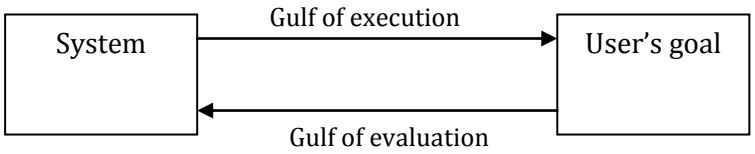


Figure 1. Norman's Execution-Evaluation Model

To pursue a task with computer support, a user needs to translate their real-world goal into a software orientated goal (also known as a system goal). The simplest case is one where the system action is identical to the real-world concepts; the aim is to enable the user's task goal to be mapped very easily onto appropriate system features. This can be very difficult to do and a number of researchers have come up with 'heuristics' to attempt to support effective user behaviour.

2.3 Heuristics

A number of advocates of user centred design have presented a set of 'golden rules' (heuristics), although they might not be suitable to every situation they do provide a useful checklist. The most well-known and used are Nielson's ten heuristics and Shneiderman's eight golden rules [1].

Nielson's guidelines are:

1. **Visibility of system status:** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2. **Match between system and the real world:** The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3. **User control and freedom:** Users often choose system functions by mistake and will need a clearly marked way to leave the unwanted state. Support undo and redo.
4. **Consistency and standards:** Follow platform conventions.
5. **Error prevention:** Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.
6. **Recognition rather than recall:** Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
7. **Flexibility and efficiency of use:** Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8. **Aesthetic and minimalist design:** Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

9. **Help users recognize, diagnose, and recover from errors:** Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10. **Help and documentation:** Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Similarly Shneiderman has developed eight golden rules:

1. **Consistency** in action sequences, layout, terminology, command use and so on
2. **Enable frequent users to use shortcuts** to perform regular, familiar actions more quickly
3. **Offer information feedback** for every user action
4. **Design dialogs to yield closure** so that the user knows when they have completed a task
5. **Offer error prevention and simple error handling** so that users are prevented from making mistakes and if they do are offered clear and informative instructions to enable them to recover
6. **Permit easy reversal of actions**
7. **Support internal locus of control** so the user is in control of the system, which responds to his actions.
8. **Reduce short-term memory** load by keeping display simple, consolidating multiple page displays and providing time for learning action sequences.

These rules are guidelines only and are not applicable to every eventuality. They will need the designers' interpretation for each new situation. However they are useful and their application will help most design project. It is now important to gain a background understanding of how these guidelines and rules can be considered through to design.

2.4 Design considerations

From preliminary research within this project it became apparent that the main issue with the existing solution was that inexperienced users (and even experienced) experience issues with understanding the sequence of actions they are required to perform in order to achieve their goal. The interface is preventing them from completed the task effectively this follows Norman's gulf of execution model.

This section will discuss how the heuristics from above can be interpreted to consider design options; it will focus on considerations for navigational design, designing to suit both novice and experiences users, and information presentation.

2.4.1 Navigation design

Much of interaction design involves goal-seeking behaviour. Users will have some idea of what they are looking for and a partial model of the system. When users are navigating through a system the important thing is not that they take the most efficient route but at each point in the interaction they make some assessment of whether they are getting closer to their (often partially formed) goal. To enable the user to do this goal-seeking each screen of the system needs to give the user enough knowledge of what to do to get closer to their goal [1].

To do this goal-seeking, each state of the system or each screen needs to give the user enough knowledge of what to do to get closer to their goal. Users will typically forage for information by navigating from page to page along links, their patterns or actions are guided by their information needs [13]. This is known as Information scenting and is a term used to describe how people evaluate the options they have and refers to the extent at which users can predict what they will find if they pursue a certain path through a website. Pirolli and Card describe information scent as "the (imperfect) perception of the value, cost, or access path of information sources obtained from proximal cues, such as bibliographic citations, www links, or icons representing the sources" [45].

Users will use proximal cues such as snippets and graphics to assess the distal content [13]. The cues such as text labels are used by users to make information seeking decisions and to guide them to their information goal. If the user feel that they are on the right track to the information they require, they will continue as long as they sense that they are "getting warmer" i.e. that the scent is getting stronger or the user will give up [46]. With perfect information scent cues a user will make no navigation errors and will proceed directly to the desired information [45]. If there is no or uninformative information scent, i.e. there are no proximal cues for the user to assess, Pirolli and Card found that the user will perform random choices in the search space as there is nothing to guide them. A site with weak or no information scent could affect users' decision to search or browse in a navigational space. This could result in the user anticipating that browsing is a more costly strategy than searching. In a study by Katz and Bryne on the effects of scent and breadth of use of site-specific search, they found that high information scent for menu options plays a key role in whether a menu will be used. With high information scent on menu options, their participant used menus even when there was a prominent search function [47].

Nielson [14] states that the most obvious design lesson from information scent is to insure that links and category descriptions explicitly describe what the user will find at the destination.

- Do not make up words or slogans as navigation options. Remember to think about the words in the users mind and therefore what they would be looking for.
- Each page should clearly indicate that they are still heading in the right direction. It should provide feedback about the current location and how it relates to the users task.

Navigational choices and search queries are driven by how well the written text semantically matches the search goal. One of the main challenges of written text is the distinction between what was actually written and what was intended. There are resulting problems with this, as there are different words that have the same meaning and some words having multiple meanings (or different interpretations by different people). The problem is that people often want to access information based on its meaning but individual words used within queries or used as part of a hyperlink do not uniquely or sufficiently express meaning.

There have been previous attempts to overcome the diversity in human word usage in information retrieval, for example augmenting the user's original query terms with related terms (e.g. from a special thesaurus). It is also possible to measure information scent using semantic similarity but this is very difficult simply because it is not feasible to ask people for similarity ratings of all words that may be used in a user interface. These methods are labour intensive and are not always successful.

Latent Semantic Analysis (LSA) is a technique for identifying both semantically similar words and semantically similar documents. It was developed to address the problem with early information retrieval systems that performed exact word matching. For example if you submit a query for 'car' you would only be returned documents or links that contained that exact word and see nothing containing 'automobile' (unless it contained 'car' also). LSA considers the words that co-occur in documents with 'car' and the words that co-occur in documents with 'automobile' , and given that they overlap significantly it is possible to determine that 'car' and 'automobile' are semantically related. LSA will produce a rank-ordered list of words that are semantically similar to it with exact names high on the list [48].

If users cannot find what they are looking for they will not be able to perform their desired tasks and will lead onto the user giving up. Preece et al [2] states that one of the usability goals is that is that the system should be efficient to use supporting the users carrying out their tasks.

Dix et al [1] lists four things to be aware of when designing each state or screen of the system:

Allowing the user to:

- Know where they are
- Know what they can do
- Know where they are going – or what will happen
- Knowing where you have been – or what you've done

To assist the user to understand *where they are* some websites show 'bread crumbs' at the top of the screen, this is a path of titles showing where the page is in the site (Figure 2 shows an example of this). This will help the user get a full sense of their current location relative to the site structure and they can jump to their desired page by a single click.

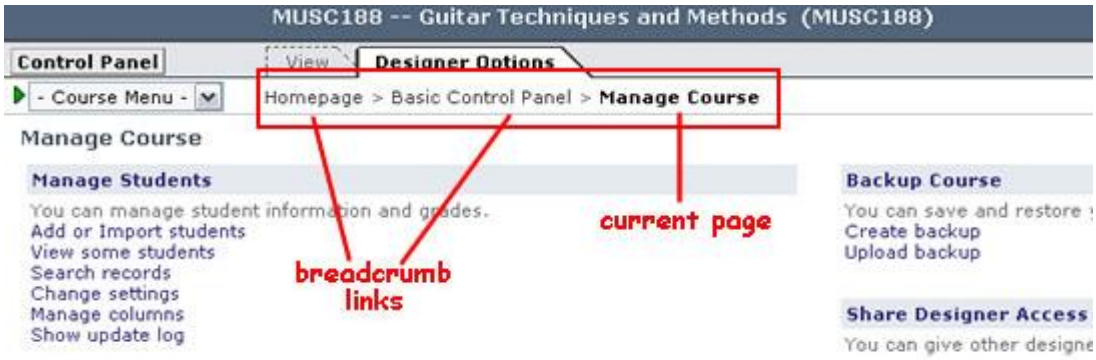


Figure 2. An Example of Breadcrumbs

They provide a trail for the user to follow back to the starting/entry point of the system/website. Although one of the benefits of breadcrumbs is the fact that they are small and therefore take up minimal space [11] Hudson [12] discusses the fact that users do often ignore them, he lists some reasons why this might be the case:

- Designers seem to be ashamed of their breadcrumb navigation, they make the text too small or hide them in the heading area or fail to use underlines to make the links obvious
- Many sites do not include them

Breadcrumbs are often used in addition to global and secondary navigation systems. There are three types: trail, path, attribute and location [49]. Path trails convey the path the user has taken through the site, and are typically represented and used with the back and forward buttons on any standard web browser. Location trails simply show the path down the website hierarchy leading to the page. Attribute trails present a particular website as a set of attributes that it conforms to. For example, a web page on a particular type of car might have a breadcrumb style trail of Ford > hatchback > under £1000 > used > blue. The difference to location trail is that this does not necessarily reflect the actual hierarchy of the web site. This paper will focus exclusively on the use of location breadcrumb trails.

Neilson advocates the use of breadcrumbs as:

- They improve the user's understanding of where they are in the site
- They are very easy to use and have never confused users in experiments
- They take up very little space on the page and never have negative effects

Previous research on breadcrumbs as a navigation tool has been limited by using simple site structures and completed within controlled experimental conditions [50].

Bernard [51] suggested that the use of breadcrumbs can aid in improving the user's mental model of the site's structure. Opponents of the breadcrumb argue that breadcrumbs are not used and they have no effect on overall navigational efficiency. Studies by Rogers and Chaparro [52] found evidence that Bernard's theory was well founded, and that users mental model of the system does seem improved when breadcrumbs are used. Maldonado and Pesnick [53] concurred that most users do not use breadcrumbs nor does it improve navigational efficiency for those who do, but Rogers and Chaparro [52] backed this but went on to conclude it can and does have a positive effect when users are trained to use breadcrumbs.

Hudson [54] attempted to explain why breadcrumbs go mostly unused, claiming that many sites do not use breadcrumbs at all, some sites are not consistent with their implementation and breadcrumbs are often small and hidden. Rogers and Chapparo [52] also found that positioning on the page affected its usage.

It is still inconclusive as to the importance of breadcrumbs as a contextual aid, but if training and familiarity is the key to its success, a familiarity that can only increase across the population of users over time, and due to its simple implementation and lack of 'harm' [55] it is likely that its usage will pick up, given sufficient time.

To assist the users to understand *what they can do* you need to make it clear which text is clickable and which is not. Sometimes this can be difficult when trying to improve the appearance of a site but it is important to note the trade-off between the appearance and the ease of use [1]. Visuals, audio and multimedia serve as a powerful illustration of concepts and ideas. It is therefore important for designers to carefully choose which visuals they use making sure that they are n necessary to assist the user, graphics unrelated to the content can cause confusion and the designer should resist the urge to make the produce more visually exciting [36].

The last two points assisting the user to understand *where they are going* was discussed at the start of this section, but also has a link with feedback and ensuring the user knows *what they have done* (which is a heuristic listed at the start of section 2.5).

2.4.2 Designing for both novice and expert users

Different users have different needs and skills meaning that help within the system might be essential to some users, whereas for more regular users of a system user support may not always be required and could potentially become irritating. Aberg [23] discusses there is a strong need to provide support to a whole range of users.

J.Wu [25] also makes the same comment by stating that novice and expert users of a system differ greatly and accommodating both in one interface is a challenge as well as a necessity for most user interfaces.

Shneiderman [24] comments that '*expert and frequent users have special needs'* and as his golden rule states it is a good idea to enable frequent users to use shortcuts. Nielson's seventh heuristic also suggest this, they are known as accelerators and are elements that allow a user to perform a frequent task quickly, even though the same tasks can be performed in a more general or slower way. These can include things like abbreviations, function keys or an entire command in a single key press [25]. Another shortcut could be allowing users to jump directly to desired locations within the system [3].

When using an interface, expert users can form goals and sequences of actions to achieve their goal much quicker than a novice user. They would prefer the number of interactions to be reduced, where as novice users would like to be able to see more of the system allowing them to gain skills and knowledge about the system to help them become experts. Novice users require

the interface to be easy to learn and guessable, this means that the users who do not have previous experience can use the interface. Some of the heuristics above support this for example recognition rather than recall and consistency.

J.Wu [25] also provides some guidelines and recommendations for accommodating for both novice and expert users:

- Design the top-level of your interface to be simplified as much as possible
- Provide accelerators for experienced users
- Show the corresponding short cut of a normal menu item within the menu item to enable users to get to know them
- Provide online help to assist novice users without getting in the way of experts
- Allow experts to change default settings where appropriate

Novice users may require additional support so the next design consideration is to gain a background understanding of how this can be done.

2.4.3 Providing user support

There are many ways of providing user support and it is up to the designer to decide on the most appropriate way for any given system. There are a number of things to be taken into account:

- Design of the user support should not be seen as an 'add-on' to system design, it should be designed with the rest of the system
- The same modelling and analytic techniques (for example task analysis) that are used for design can also guide the design of support material

It is necessary to make decisions about how the help will be presented to the user, how will the help be requested? How will it be displayed to effectively assist the user?

Help may be a command, a button, a function or a separate application. A command will usually require the user to specify a topic, and therefore assumes some knowledge, a help button is readily accessible and does not interfere with the application, a help button could support context-sensitive help [1].

Context-sensitive help allows the user to get information about a specific area of a system; it provides information that is relevant to the task the user is currently trying to accomplish. It ensures that the information is timely, but if the type and scope of the help is not tuned to the user's needs then it will not be helpful. Frimm [26] completed some analysis of user needs and observation of user's interaction with a system and has indicated a requirement to offer the following types of context-sensitive help:

- 'Where you are' (example solution breadcrumbs)
- 'What you can do' both goal and command orientated
- Field options, values that can be applied to the current field
- Help on the current condition, if one exists

It is important to consider how this help will be displayed to the user, it could be in a new window or it may use part of the screen. Alternatively help hints, prompts or pop-up's can be given as the user requests it. The presentation style that is appropriate depends largely on the level of help being offered and the space required; this will develop from the design of the help functionality.

The physical layout of documentation can make a different to its usability, for example large blocks of text are difficult to read on screen and may require the user to search for the help they require. A useful style is to provide a summary of the key information prominently with further information if required. An index can be a useful summary but should be organized to reflect the functional relationships between the subjects rather than alphabetic ordering [1]. As already stated the help system will need to be designed just as the rest of the system is, therefore the heuristics will also need to be consisted, for example consistency will have a significant play within the help system.

Consistency is important to consider when designing the presentation of information on the user interface.

2.4.4 Information presentation

It is also important to consider how information will be presented on screen; this issue has been around for many years, long before computers and therefore interactive systems. Obviously the presentation of information on the screen depends on the kind of information; different purposes will require different representations [1]. But obviously it is important to continue to consider new users and therefore it is advisable that screens should be simple, it is easy to overload a new user with too much information as this can be frustrating [36].

When presenting information it is also important to consider colour, when used incorrectly it can seriously hamper communication. Macfarland [37] recommends perceptual areas such as using a soft non-intrusive background colour such as soft greys to prevent eye fatigue. A consistent colour scheme should be used throughout and appropriate colours for each function, for example red for stop. It is also worth noting that colour is not completely reliable considering that 10% of males show some indication of colour blindness [36]. Preece et al [2] discusses the structure of information and show good examples where information has been ordered into meaningful categories which appropriate blank spacing between enabling easier reading for the user.

There is an advantage when presenting information in an interactive system in that it is easy to allow the user to choose among several representations so making it possible to achieve different goals.

Now that a good background understanding of the design principals and how these can be interpreted to consider design options has been achieved the next step is to consider the process by which such designs can be implemented.

2.5 User centred design

Now that I background research into HCI, understood the heuristics and considered how these affect designers decisions I will now move onto the process of designing.

User centred design puts the users at the centre of its design and development, they should take part in the decisions that affect and the way that it is designed and used.

As stated in the introduction there are four stages to interaction design, these stages are carried out in an iterative fashion with cycle's being repeated until usability objectives have been attained, this process is shown in figure 3.

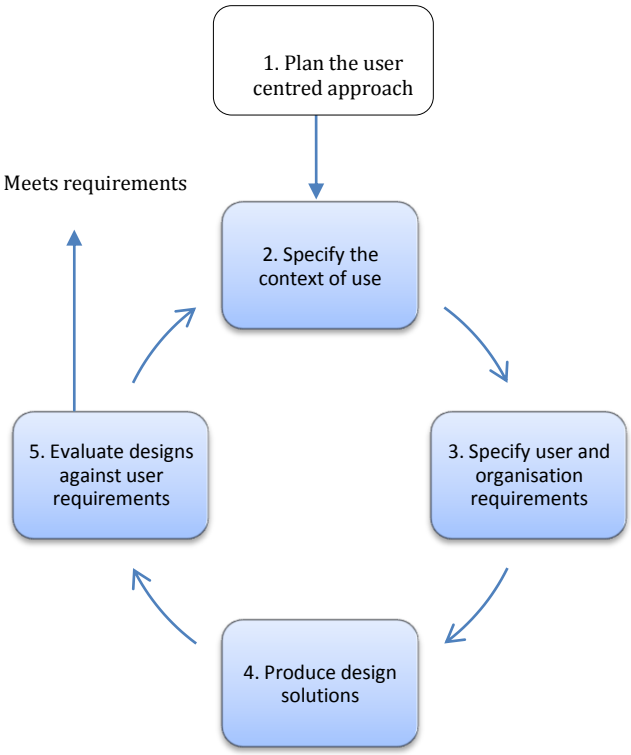

1. Plan the user centred approach
Meets requirements
2. Specify the context of use
3. Specify user and organisation requirements
4. Produce design solutions
5. Evaluate designs against user requirements

Figure 3. The User Centred Design Process

Early in design phase the design solutions are likely to be mock-ups and prototypes, as the design progresses higher fidelity designs will be evaluated against more specific requirements [16].

The following table shows a high-level characterization of the most popular user centred design methods: [17]

Method	Brief description	Sample size
Focus groups	Facilitated discussions to share ideas & opinions about the system	**Low**
Contextual inquiry	Field study where designers visit the users workplace to analyse habits, activities & environmental factors	**Varies**
Usability testing	Users work with the prototype to perform given tasks (see section 2.6)	**Low-Medium**
Card sorting	Information is written on individual cards, users then sort depending on some given criteria	**High**
Participatory design	Users join the design team (See section 2.4.3)	**Low**
Questionnaires	Users are asked a standard set of questions	**High**
Interviews	Semi-structured questions are asked to: stakeholders, content experts, support staff, and users themselves.	**Low**
Task analysis	Identify steps required through interview or observation (See section 2.4.2)	**Low**

Table 1 User centred Design Methods

Table 1 is an important summary and highlights the key methods that will be used throughout this project. Although a variety of these methods will be used throughout the project, this next section will take a greater look at the two most significant methods involved in user-centred design, task analysis and participatory design.

2.5.1 Why user-centred design?

As pointed out by Ellen Bravo at a conference in 1990 leaving users out can have disastrous effects not just on the task goals but on the users themselves [7]. Alison Black [18] states that *"the most successful designs come from understanding the needs of the people that use them."*

Early involvement of users with the future system may lead to adjustment of their expectations making the eventual acceptance more likely [7]. This in turn could potentially lead to cost reductions due to early acceptance and reduced development costs.

The process of understanding the user's expectations means the designer needs to understand the role of the computer system. This can be done using task analysis, it allows the major task to be broken down into sub components, this will continue until the task can no longer be broken down into individual sub-components.

The process of user centred design obviously requires interaction with a number of stakeholders and as discussions earlier in this chapter has already shown, the design of a usable system can only be successful by learning, interpreting and understanding the user's needs. There are a number of methods that can be used in the requirements phase to begin to understand users, one of the most commonly used techniques is task analysis.

2.5.2 Task Analysis

Task analysis is mainly used to investigate existing solutions and is used to establish a foundation of existing practices on which to build new requirements or design new tasks. It analyses the underlying rational and purpose of what users are doing, trying to achieve and how they are going about it. Task analysis is a term that covers techniques for investigating cognitive processes and physical actions at a high level abstraction and in detail. The most widely used version is Hierarchical Task Analysis (HTA), another well known technique is GOMS (Goals, Operators, Methods and selection rules) [2].

HTA was originally designed to identify training needs, it is a hierarchy of tasks and sub-tasks. It describes what order and under what circumstances sub-tasks are performed. HTA focuses on the physically and observable actions that are performed, it also includes actions that are not related to the software at all. The starting point is the user goal; the tasks associated with this are identified and then sub-divided as appropriate [2].

GOMS was developed in the early 1980's as an attempt to the knowledge and cognitive processes involved when users interact with a system.

Goals refers the goal that the user is trying to accomplish

Operators refers to the cognitive processes and physical actions that need to be performed in order to reach that goal

Methods are the learnt procedures for accomplishing the goal; they consist of exact sequence of steps required

Selection rules are used to determine which method to select when there is more than one available for a given stage of a task

After the initial practices and processed have been understood the next most significant user centred techniques is participatory design. Users will participate during the initial exploration of the problem identified to help define and focus ideas for the solution, right throughout development through to evaluations of proposed solutions. This is the most important part of ensuring the solution is exactly what the users want and need.

2.5.3 Participatory design

Computer systems development will always be accompanied by the problem of how to define requirements for the functionality. Participatory design is about establishing meaningful and productive interactions among those users who are directly impacted by the change in technology. Participatory design represents a traditional break with traditional approaches to system development.

Computer applications need to be better suited to the skills and working practices of the people using the system. Barriers between designers and users need to be broken down in order to build effective communication throughout the design process. Bodker [30] states that users and designers have different backgrounds and belong to different communities of practice. The practice of users is the starting point for design, but at the same time users need to see and experience new ideas in order to transcend their own practice. Participatory design stresses the importance of active participation of end users throughout the project from initial research through to design and evaluation, they should take part in decisions that affect the system and the way in which it is designed and used. Because technology is not developed in isolation, participation in decisions about technology also involves decisions about work content and job design [7].

'Bridging the gap' between designers and users is not an easy task, as Kyne [22] discusses answering questionnaires and discussing requirements specifications are not suitable since users don't have the professional knowledge and skills that form the basis for high quality user contributions. Therefore supplementary tools and techniques have been developed to enable users to contribute; these include paper and pen exercises, brainstorming, storyboarding and workshops [1]. Finally actively involving users allows them to reflect their own work and bring innovative ideas to the design process.

Henderson [21] discusses three main guidelines as an approach to participatory design:

- **The goal is to improve the quality of work life:** Both the users and the developers share this objective; the focus is not solely on the design of technology. It may include things like reallocating tasks or moving furniture and the technology might allow or require this. The focus is the work as a whole and the technology is only a component of this.
- **The orientation is collaborative:** Both designers and developers are actively involved in decision making, it is recognised that knowledge from both will be required for successful technology. Through reflection and experience the users will become familiar with technology as designers will with work practices.
- **The process is iterative:** Emerging design ideas will need to be tried out in a work environment. It requires developing ways of presenting ideas to users such that they begin to get an idea of what it would be like to use this technology in their work. Mock-ups, scenarios and prototypes are some of the ways to allow users this early exposure.

It is often said that users cannot tell you what they want, but when they see something and get to use it they are soon able to explain what they want [2]. Therefore as the final bullet points suggests, once initial information has been collected about the task and the user's opinions it is worth building iterative prototypes. A prototype can be a paper-based outline of a screen or a set of screens, an electronic 'picture', a video simulation, a cardboard mock-up or a piece of working software. It allows stakeholders to interact with the envisioned product to gain some experience, explore imagined uses and suggest improvements.

Lichter [32] defines prototyping as an approach based on an evolutionary view of software development, affecting the development process as a whole. It involves producing early working versions "prototypes" of the future application and experimenting with them. It provides a communication basis for discussions among all groups involved in the development process,

especially between users and developers. Floyd [33] discusses the different goals of prototyping:

- **Exploratory prototyping** is used when the problem is unclear, initial ideas are used as a basis for clarifying what users and management want. It helps the developers gain an insight into the application area and the user tasks.
- **Experiment prototyping** focuses on technical implementation of the development goal, it helps ensure feasibility of a particular application.
- **Evolutionary prototyping** is a continual process for adapting an application to organizational constraints and requirements; it allows the developers to work in close cooperation with the users to continue to improve the system.

Firstly a low-fidelity prototype will be produced, these are generally limited function, they are constructed to view concepts, design alternatives and screen layouts rather than model the user interaction with a system. In general they are constructed quickly and provide limited or no functionality; they demonstrate the general look and perhaps feel of an interface. They are generated to communicate, educate and inform but not to train, test or serve as a basis on which to code. Rudd et al [34] discuss some of the advantages of low-fidelity prototyping:

- Huge value in the early requirements gathering and analysis phase, it can act as a communication medium by which requirements can be developed.
- They can be constructed early in the development without a large investment in cost and time.
- Since they are constructed on paper, they require little or no programming skill.
- They are easily portable and easily presented; it can be easily demonstrated to potential users to quickly obtain feedback on how well the design meets their needs.

Paper-based prototypes or screen mock-ups offer a way to make effective use of the users experience, two specific examples of this technique have been developed for participatory design, and these are PICTIVE and CARD.

PICTIVE (Plastic Interface for Collaborative Technology Initiatives through Video Exploration) is a technique that uses a combination of low-tech design components with video recording facilities. It is useful for increasing the direct and effective involvement of end users and stakeholders in the design. Office materials such as sticky notes, highlighters, labels, paper and scissors are used on a shared design surface to produce low-level prototypes. Some of the benefits of using materials like this include:

- Such low-technical objects insures that all participants have equal opportunities to share their ideas
- They are inexpensive and encourages the participants to be bold with them, hopefully stimulates inventive design and creative problem resolution
- They are easy to change and move around meaning that many variations can be tried quickly and easily

This technique was developed by Muller [27] in 1991, he describes that PICTIVE is intended less as a means for the evaluation of an already designed interface, but rather for the creation of the design of an interface, its purpose is to involve all possible stakeholders meaning that participants did not have to be technology experts to assist with design.

A **PICTIVE** session may be a one-to-one collaboration or it might involve a small group, participants will be asked to prepare before the session. Typically this will be the user considering a task scenario (for example asking them to prepare what they would like the system to do for them) and the developer considering an initial or preliminary set of components based on prior discussions. Each participant will then share their expertise at the design surface to produce their potential designs together. Since sessions are recorded on video

tape it prevents there being a need for a "note taker" and so allows the participants to work more effectively together [7]. This design technique has been effective but can be time consuming for larger systems [29]

CARD (Collaborative Analysis of Requirements and Design) is another participatory design technique. It is primarily used for analyzing and redesigning task flows within a system. Like PICTIVE, it can be used one-to-one or in groups, It is an informal or semi-structured "card game" that supports analysis and critique of a system. As described by Tudor [35] although the PICTIVE technique has been effective, sessions are time consuming and tend to dive immediately into detailed design, the task flow is often assumed to be correct, rather than critically examined. Whereas with CARD it is intended to focus on the flow of the users task, detailed design work can then be done using PICTIVE, these two techniques therefore complement one another.

With the growing recognition that an understanding of the users work practice would be useful in the design of a new system, there has been a surge of interest in another technique for participatory design, ethnography. This is an observational technique; it seeks to understand settings as they naturally occur, rather than in artificial or experimental conditions. Although this technique has the most significant benefit of fully understanding the end users it also has a number of issues. It usually involves quite lengthy periods of time at the study site and once completed the presentation of the results is frequently not represented in a way that is useful to designers [31].

There is a vast amount of stakeholders that could potentially be involved in participatory design these include end-users, developers, human factory workers, technical writers, systems analysts, trainers and marketing staff. All can make a difference if they are part of the design and all will have their work lives influenced by the design one way or another [28].

Once a design has been generated it will need to be evaluated not only against the requirements specification but also against previous designs, again it will also require direct involvement of stakeholders.

2.6 Usability Evaluation

Usability evaluation is a means of collecting information about the users experience when interacting with a prototype. As stated throughout this chapter a user-centred approach is being taken, for this to work effectively evaluation techniques will need to be used throughout the design and development life-cycle to provide feedback, this means that the results of evaluation will lead onto modifications of the design by amending it to suit users needs. Without evaluation designers cannot be sure that the system is usable and what the users want, the main requirement for an exemplary user experience is to meet the exact needs of the users without fuss or bother [2]. This therefore highlights that evaluation is a key area to ensuring this is possible and therefore having a successful end system.

There is a close link between evaluation and prototyping techniques (as previously described). As Dix et al states [1] evaluation has 3 main goals:

- To assess the extent and accessibility of the systems functionality
- To assess the user experience of the interaction
- To identify any specific problems with the system

As already stated above the systems functionality is extremely important since the user must have all that they requested, secondly this functionality must be clearly reachable by the users in terms of the actions that the users need to take to perform the desired task. Aspects like how easy the system is to learn, the users satisfaction and enjoyment is important to assessing the

user experience. Finally any problems with the system will have a direct impact on the usability and therefore these also need to found as early on in development as possible.

Since the aim is to continuously evaluate, it will not be possible to carry out extensive experimental testing throughout the design therefore it will be analytic and informal techniques that will be used, this section will now highlight some of these [1].

Rosson and Carroll [3] state there are two types of evaluation and both of which will be used.

- ***Formative*** takes place during the design process, each developed prototype will be evaluated. The goal of formative evaluation is to identify aspects of the design that can be improved and set priorities.
- ***Summative*** is completed to access the design result and therefore is most likely to happen at the end of development (although it can be completed at critical points during development). Its goal is to answer questions like 'does the system meet its goals' and 'is the new system better than the previous'.

There are two general classes of evaluation methods; analytical evaluation and empirical evaluation. Analytical evaluation does not involve users instead analysts or experts will do the evaluation, where as empirical evaluation will involve users. These are complementary to formative and summative goals.

2.6.1 Analytical Evaluation

Analytic methods do not involve users. An important motivation for analytical methods is that they can be used early on in the development phase. The first evaluation of a system should ideally be performed before any implementation work has started. If the design itself can be evaluated, expensive mistakes can be avoided since this allows the design to be altered prior to any significant resource commitments. The intention is to identify any areas that are likely to cause difficulties because they violate known cognitive principals, or ignore accepted empirical results. These methods can be used at any stage in the development process making them flexible. A number of methods have been proposed [1]. The two most used are:

Cognitive walkthrough was originally proposed as an attempt to introduce psychological theory into informal and subjective walkthrough technique. It involves one or a group of evaluators (these are experts rather than users for example HCI experts, software developers or designers) inspecting a user interface by going through a set of tasks and evaluating understandability and ease of learning.

Walkthroughs require a detailed review of a sequence of actions, these refer to the steps that an interface will require a user to perform in order to accomplish a particular task. The evaluators simulate users by stepping through that action sequence to check for potential usability problems. They will provide a *story* about why that step is good or bad for a new user.

To do a walkthrough you need four things:

1. A specification or prototype of the system
2. A description of the task the user is to perform using the system
3. A complete written list of the actions needed to complete this particular task
4. An indication of who the users are and what kind of experience and knowledge can assumed about them

Given this knowledge the evaluators will now critique the system by trying to answer the following questions at each step:

1. Will the users try to achieve the correct effect?
2. Will the user see that the correct action is available?
3. Once the user has found the correct action, how will they know it's the one they need?
4. If the correct action is performed, will the user see that progress is being made towards the solution of the task? Are they able to understand the feedback they are receiving?

It is important to document the walkthrough to keep a record of what needs improvement and what works well, it is therefore a good idea to produce standard evaluation forms. It can also be useful to indicate the severity of the problem, whether the problem could occur often or how serious it could be for the users [1].

The second approach is **Heuristic evaluation** which uses the heuristics discussed earlier in the chapter. It is an informal method of usability analysis where a number of evaluators are presented with an interface design and asked to make comments. It was first developed by Nielson and Molich. The general idea is that several evaluators will independently critique a system to come up with potential problems.

Nielsen and Molich [5] conducted four experiments to investigate how many evaluators are sufficient to find the maximum number of usability problems. He found that individual evaluators were quite bad at doing evaluations individually since they only found between 20-51% of the usability problems they evaluated. Figure 2.8 shows how increasing the number of evaluators just by 2 or 3 there is significant improvement.

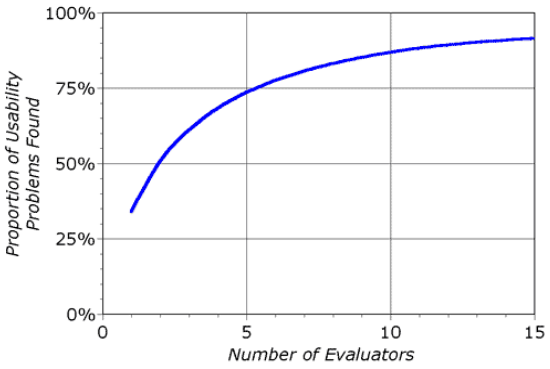


Figure 4. Graph Showing Proportion of Usability Problems Found By Evaluators

The study showed that heuristic evaluation is difficult and that you should not rely on the results of having a single person look at an interface. They will be much better if you have several people conducting the evaluation, and should do some independently of each other. As figure 2.8 shows the number of usability problems found grow rapidly in the interval from one to five evaluators but reaches a point around 10 evaluators. Nielsen and Molich [5] recommend that heuristic evaluation is done with between 3 and 5 evaluators and that any additional resources are spent on alternative methods.

To aid the evaluators in discovering the usability problems a set of heuristics (which were previously discussed in section 2.2.2) are provided to evaluate whether the interface elements conform to the principals, these are listed and discussed in section 2.2. Each evaluator assesses the system and notes violations of any of the heuristics that would cause potential usability issues. The severity is then assessed based on four factors:

1. How common is the problem?
2. How easy is it for the user to overcome?
3. Will it be a one-off problem or persistent?
4. How seriously will the problem be perceived by the user?

Even though severity has several components it is common to combine all aspects into a single rating as an overall assessment to facilitate prioritising. This is usually within a scale of 0-4:

0 = I don't agree that this is a usability problem at all
1 = Cosmetic problem only: need not be fixed unless there is extra time available
2 = Minor usability problem: Fixing this should be given a low priority
3 = Major usability problem: Important to fix
4 = Usability catastrophe: Imperative to fix this before the product is release

Nielson [6] states that it is difficult to get a good severity estimate from evaluators since they are more focused on finding new usability problems. Each evaluator will only find a small number of the problems and therefore their decisions on severity are based on just the set of problems they identified. Instead it is a good idea to set the severity ratings once the evaluation session is complete, this can be done by sending out a questionnaire listing the complete set of identified problems and asking then asking each evaluator to rate each usability problem. It is important to note that each evaluator should produce individual ratings independent of other evaluators.

Nielson also states that severity ratings from a single evaluator are too unreliable to be trusted. As just described above the more evaluators asked to judge the severity of usability problems, the quality of the severity rating increases rapidly, and using the **mean of a set of ratings from three evaluators** is satisfactory for many practical purposes.

2.6.2 Empirical Evaluation

Empirical methods involves studies of actual users, they can be relatively informal for example observing people while they explore a prototype, or they can be formal and systematic such as in a controlled laboratory to study performance times and errors. Regardless of the care with which the data is collected the interpretation of the empirical results depends on having a good understanding of the system being evaluated [3]. Preece et al [2] further split empirical evaluation out into two different approaches, usability testing and field studies.

Usability testing is conducted in a laboratory or laboratory like conditions isolating the user from normal day-to-day interruptions and noise. Taking users out of their working environment makes the commitment to usability clear to users [4]. This method is important particularly at the later stages of design. Preece at al [2] states usability testing involves measuring typical user performance on typical tasks, and will include things like:

- Time to complete a task
- Time to complete a task after a specified time away from the product
- Number and type of errors per task
- Number of errors per unit of time
- Numbers of navigations to online help or manuals
- Number of users making a particular error
- Number of users completing a task successfully

This will provide empirical evidence to support a particular claim or hypothesis. It is important to manipulate the context by moving users out of their usual working environment in order to uncover problems or observe less used procedures.

Any experiment has the same form and the evaluator will choose a hypothesis (these are often based on theory or previous research findings) to test. A number of experimental conditions are considered which differ only in the values of certain controlled variables. There are a number of factors that are important to the overall reliability of the experiment which must be considered

during the design. This includes participants chosen, variables tested and manipulated and the hypothesis tested. According to Preece at al [2] it is considered that 5-12 users is an acceptable number to test in a usability study, although sometimes it is possible to use fewer where there are budget and schedule constraints. For example quick feedback about a design idea can be obtained from 2 or 3 users.

An effective technique during usability testing is to invite users to *think aloud* about what they are doing. This can yield clues to assist the evaluator for example user comments like "This text is too small" or "I can't find this menu for…" Afterwards the participants can be invited to make general comments or suggestions; this informal atmosphere often leads to many spontaneous suggestions for improvement. Sometimes if two participants are working together produces more talking as one participant explains procedures and decisions to another [4].

This project will use field studies, these are conducted within the user's everyday working lives, they are typically conducted to find out how a product or prototype is adopted and used by users in their normal circumstances. Evaluating how people think about, interact and integrate the product within the setting it will ultimately be used in will give a better sense of how successful the product will be in the real world [2]. The nature of this situation means that you can observe interactions between systems and individuals that would have been missed in a laboratory study. Field studies can be used to:

5. Help identify opportunities for new technology
6. Establish the requirements for design
7. Facilitate the introduction of technology or deploy existing technology in new contexts
8. Evaluate technology

The basic techniques for data gathering in field studies are interviews, questionnaires and observations. The studies to be reported here relate to the improvements in the user interface design.

Both of the methods described above have limitations Shneiderman [4] highlights some of these. Testing in this way does emphasise first time use and can have limited coverage of the interface features. Since usability tests are often short, it is difficult to ascertain how the performance will be after regular usage. Preece at al [2] also describes some practical issues, these include things like access to appropriate users this might be dependent on schedules or budgets. There might be situations where the evaluators have experienced surprise events that require a decision to be made there and then. You also need to consider users themselves, for example they might not be a valid representation of the user population the end product is aimed at. The evaluator should also consider and be aware that some users might be anxious and uncomfortable when they make mistakes, this could potentially lead them to not acting in their usual way. Therefore it is important that evaluators put the users at ease.

2.7 Conclusion

This chapter has focused on some key aspects of HCI, usability, guidelines affecting design considerations and design and evaluation techniques, each of these will need to be considered when moving through the project. This literature review has also looked at the importance of following the HCI principles and how these guidelines can influence the design considerations for incorporating user support and effective navigation. Breadcrumbs has been highlighted as a potential solution to aid the user navigating the system, this chapter has also covered some guidelines to support designing interfaces for both novice and expert users.

The entire literature review had a significant focus on the importance of involving stakeholders throughout the project. It is now possible to begin bringing all stakeholders ideas together to form directions on the new implementation of the OneLilly targeting system.

The next chapter focuses on building up an understanding of the stakeholder's requirements. It is now important to continue to refer back to this chapter throughout the project ensuring the research is put effectively to use.

Chapter 3

Requirements

In Chapter 2 an overview of the concepts and processes of which need to be considered throughout the project were given included a description of the process of user-centred design. The first step in this process is to identify user needs. Preece et *al* [2] state that this is 'to understand as much as possible about the users, their work and the context of that work so the system in development can support them in achieving their goals'.

The aim of this chapter is to focus on gathering requirements from the stakeholders of the OneLilly targeting system, and documents the approaches taken. This will include gaining a greater insight into the targeting process, completing interviews and an observation with a selection of the stakeholders and completing task analysis. The chapter will conclude by discussing the stakeholders chosen priorities and detailing the requirements specification.

3.1 Data Gathering

A requirement is defined as a statement about an intended product that specifies what the product should do, or how it should perform. It is important to make each requirement as specific and unambiguous as possible. The overall purpose of collecting data in this phase is to collect sufficient, relevant and appropriate data to enable such requirements to be formed. Data gathering is used to find out about the tasks users currently perform and their associated goals, the context in which the tasks are performed and the rationale for the current situation.

The requirements will be formed from a number of different sources, as shown in Figure 5

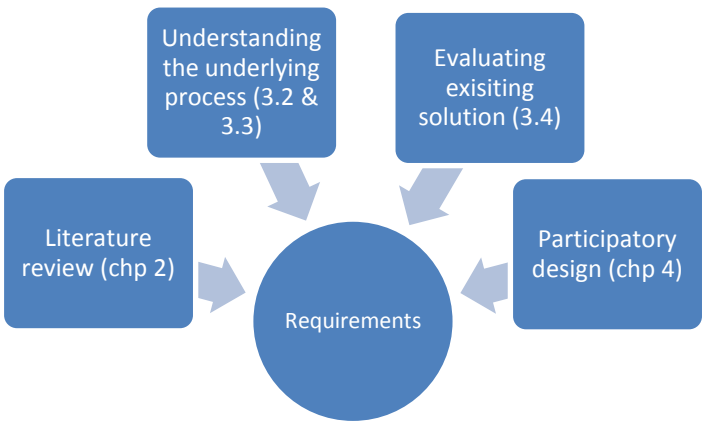

Understanding the underlying process (3.2 & 3.3)
Evaluating exisiting solution (3.4)
Literature review (chp 2)
Participatory design (chp 4)
Requirements

Figure 5. Formation of The Requirements Document

As stated in the previous chapter, there is a strong focus on the necessity of involving stakeholders, and the detailed process of participatory design achieves this objective. It is also useful to gain an understanding of the purpose of the system in question - the knowledge gained here will be applied throughout the project.

3.2 Overview of the targeting process

It is useful at this point to introduce to the targeting process and how the current system plays a vital role in the preparation of data. This overview is based on personal knowledge gained whilst on placement at Lilly.

The targeting process generates data for loading into a global CRM system named 'OneLilly'. It is used on a quarterly basis, when data for each of the eight sales forces are generated. There are other scenarios when data must be updated outside of this schedule – for example, if new sales representatives join the company, or roles of existing sales people change.

The stakeholders refer to the data as 'objectives', of which there are three types:

- Sales Quota - the target amount (in GBP) of a given product that sales representatives must aim to sell in a specified time period.
- Time Management - how a sales representative's time should be split for a specified time period. This indicates how many days each sales representative should be visiting customers, completing training, or performing administrative tasks.
- Call frequency - the frequency with which a sales representative must visit a targeted customer in the specified time period.

Each individual objective 'belongs' to an objective and each objective is part of a business plan. Figure 3.2 gives a pictorial view of how the data is structured.

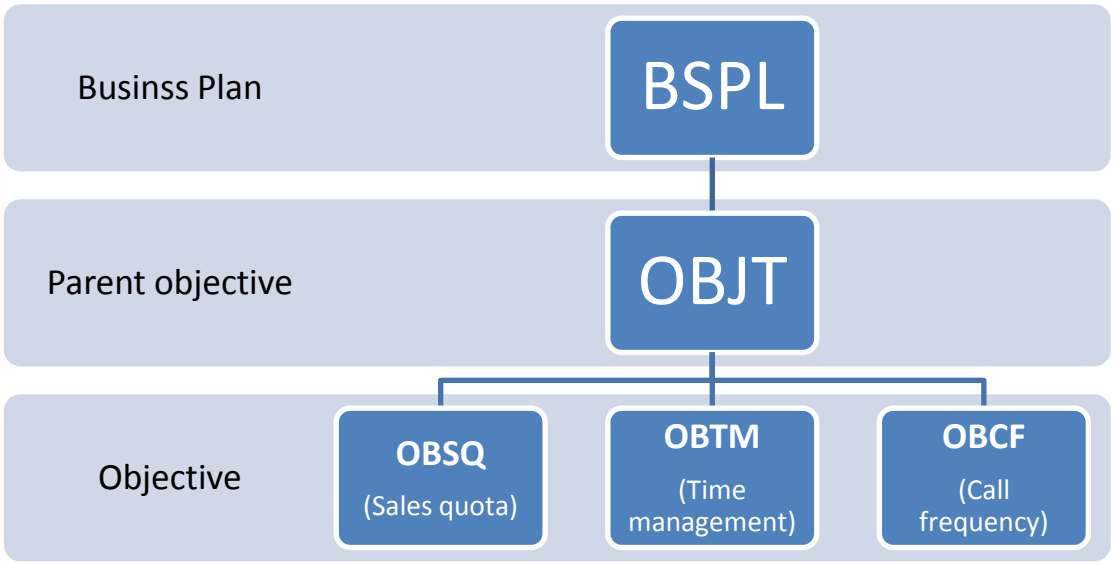


Figure 6. Structure of the Targeting Data

Time management does not form an inherent part of this project since this data type is currently unstable. This decision was taken by the company and it is possible that when stability is achieved this maybe a future enhancement to the system.

As an example figure 7 shows the data required for one sales representative targeting 100 customers with two products.

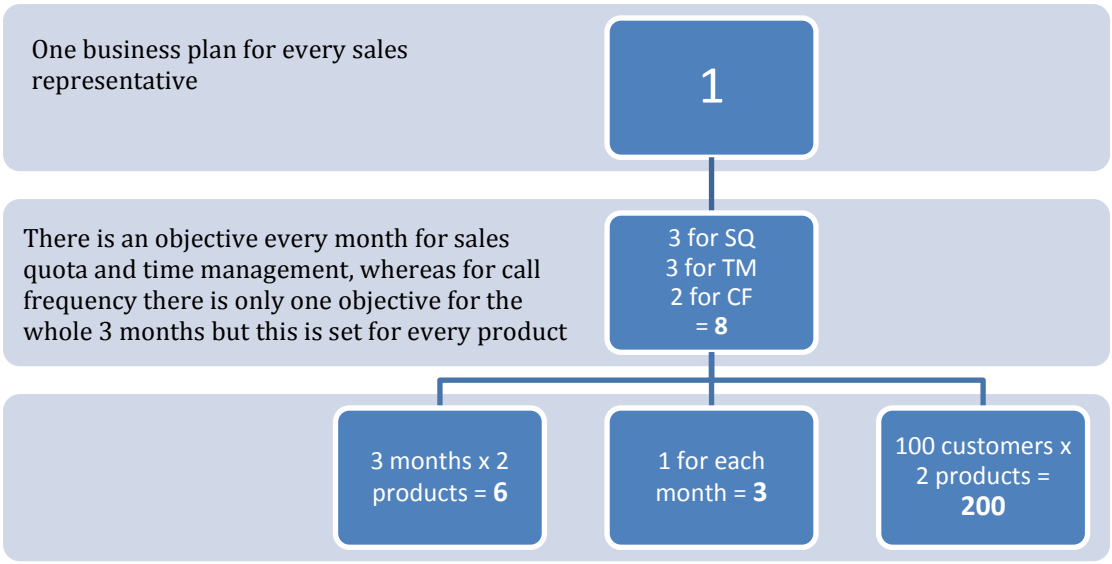

One business plan for every sales representative
1
There is an objective every month for sales quota and time management, whereas for call frequency there is only one objective for the whole 3 months but this is set for every product
3 for SQ
3 for TM
2 for CF
= 8
3 months x 2 products = 6
1 for each month = 3
100 customers x 2 products = 200

Figure 7. An Example of the Data required for one sales representative

As shown, 218 records are required for one sales representative. This gives an impression of how time consuming completing this task manually would be, and goes a way to demonstrating how important it is to have an effective support system in place.

The targeting solution has recently undergone a redevelopment during the new release of a CRM system. Prior to the current Microsoft Access solution, users completed the task "manually" (albeit with use of a spreadsheet). Previous to the introduction of this system, users would take up to six weeks to compile targeting data - the current solution reduced this significantly, but as previously described, the solution was not developed with any regards to users meaning a lot of their understanding was lost making the tool difficult to use.

The requirements gathering process will begin with interviews with stakeholders.

3.3 Interview with stakeholders

Beginning the requirements gathering phase with interviews will give a good introduction to the current process and allow us to see where potential issues lie.

Two operational data stewards are the main users of the current tool, one as the primary user and the other as a secondary user. In addition, three business data stewards in the team could potentially be asked to use the tool to support the main users. Users have a range of experience and technical abilities. Besides users, other potential stakeholders are:

- Business integrators, who directly support and assist users with the tool
- RADS (Regional Applications Development and Support), a technical group with which business integrators liaise. This group that will support the solution and carry out any technical fixes required.

For the purpose of these initial interviews a selection of stakeholders will be used: the primary user, a business integrator and a member of the technical support group.

3.3.1 Interview Process

Interviews will be semi-structured and informal. This will allow preparation of a basic script to ensure necessary points are covered, and ensure some degree of consistency in the questions put to each interviewee. This interview style will also provide opportunity for interviewees to explore avenues that had not previously been considered.
Our aims in conducting the interviews are:

- To gain an understanding of what users consider to be the good and bad points of the existing system
- To understand the reasons behind these thoughts
- To understand the changes users would like to see in a redeveloped system.

All interviews will be recorded using a Dictaphone for later review.
All interview participants were sent a brief email prior to the interviews outlining the questions and informing them that the interviews will be recorded, a signed copy of this along the supplementary notes that were taken can be found in Appendix A: Section 1.

3.3.2 Questions

Below is a list of the questions that were asked of each interviewee.

1. What is good about the current tool? Are there any features you like about the current tool?
2. Are there any features you would like to see retained from the tool? Alternatively, is there a process or understanding you have from completing the task manually that you would like to be able to see in a new system?
3. Do you find the current tool easy to use? If so what makes it easy to use? If not can you describe why it is difficult to use?
4. What is bad about the current tool? What frustrates you about it? What features would you like to see removed?
5. What new features would you like to see?
6. Do you have any comments on user experience of the current tool in general? Can you suggest anything that would enhance the user experience?
7. Can you prioritise enhancements and new features?
8. Do you have any further comments?

3.3.3 Background of interviewees

Interviewee 1	Operational data steward – OneLilly team
Interviewee 1 is the main user of the current tool. It is her responsibility to generate the objectives files using this tool on a quarterly basis. She is involved in the business rather than IT, and does not come from a technical background. However, over the past year she has started to develop some skills using the current Microsoft Access tool aided by training.	

Interviewee 2	Business Integrator - Pharma IT team
Interviewee 2 is part of the IT functional area, and has a more technical background. She has a good understanding of the current tool and her role is to suggest and provide IT solutions to the OneLilly team. After the current tool was created, Interviewee 2 took responsibility for it, and thus has a good understanding of its structure, use, problems and benefits.	

Interviewee 3	Technical support - RADS team
Interviewee 3 has the most technical background of the three. His role is to give technical support for existing systems. The existing tool developed using Access requires additional support, for which he is responsible. He often assists with tasks such as updating SQL where required, and to provide backup to the first line support.	

3.3.4 Analysis

All three interviews were conducted on October 30th 2007, and each lasted approximately 45 minutes. From the responses it was clear that users viewed the tool from different perspectives, the primary user discussed functionality she liked in the existing tool, whereas the business integrators discussed aspects such as maintainability and ease of support.

There were a number of good aspects to be noted about the current tool. The primary user is impressed with the functionality of the tool since it allows her to complete her task within a few hours whereas previously it took several weeks. However, numerous suggestions about the look and feel of the system describing many of usability issues were made, and the more technically minded interviewees criticised the tool's lack of maintainability.

Once all interviews were complete, a brainstorming session was undertaken where all three interviewees shared their responses. This proved successful, since some of the responses turned into debates and many of the ideas were expanded upon.

Having analysed the responses, it was found that answers fitted into three distinct categories:

- Presentation - how the users view and perceive the system, and their comments on its appearance
- Interaction - how the users use the system and how comfortable they felt navigating it in order to achieve their goals
- Context - what the users described as the functionality of the system

Below a summary of the results is given. Full interview transcripts can be found in Appendix A: Section 1.

Presentation

Users commented that since the current tool is based on Microsoft Access, the 'look and feel' is consistent with other applications with which they are familiar. For the purpose of this tool this does not support the usability, however.

A comment was made about Access allowing a diagrammatic view of SQL queries. This is useful because users and business integrators are required to manually update SQL this is difficult and the diagrams assist them.

The currently the tool is made up of seven different databases (for each sales force) each of which is set up slightly differently, causing confusion for users.

Interaction

Every interviewee commented on the navigation of the tool. There is no logical sequence of actions and this makes it extremely difficult for new users to understand and use.
Some of the comments made regarding this included:

- The sequence does not follow that of the previous solution
- Undesirably the system allows you to navigate anywhere and edit anything in any order
- It is very difficult to navigate around or understand what the next action should be, and users always need instructions in front of them
- It is not intuitive
- A good technical understanding is needed to follow it through

All of these comments suggest the usability of the existing tool is very poor. Users communicated that is extremely difficult and near impossible to work out the process which must be followed to produce the correct output without being given a considerable amount of guidance and training, thus restricting the number of people who can support the primary user.
One of the interviewees made the commented that "[currently] the user is guiding the system but it should be the other way around - the system should work in the same way that the user would think".
Several comments were made about how comfortable the users felt using the system. These included:

- "I am extremely worried that if I do the slightest thing wrong I will have to start again"
- "Sometimes the system does things without telling me"
- Error messages can be very difficult to work out without a technical understanding of how Access works
- Any invalid data is simply removed without informing the users. Although such removal is good for removing undesirable incorrect data, giving feedback to understand why this is being done, and potentially allowing updating of the data would be better.
- There are numerous places where there is not enough feedback regarding what the tool is doing.

All of the SQL is visible to users, instilling fear in non-technical users. Displaying SQL in this manner is not appropriate since it is very easy to edit tables or queries, which may result in system failure. However, being able to access the code easily does allow for flexibility and makes support easier. This is because in the current state, support can be given immediately by a business integrator, whereas a formally developed system would be supported by the main technical group which follows stringent change control procedures. However, the balance between usability and flexibility in this case is very unsatisfactory and misguided for the users of the application resulting in system failure, or incorrect and un-validated data being produced.

Context

In terms of functionality, the users like the current tool. The following points were highlighted as being particularly important:

- The checking of input files to ensure data is valid - important since the global OneLilly application allows the sales representative to enter any value.
- Updating the cross-reference table automatically with any necessary additional values is useful.
- Removing invalid data from the output file automatically – although note the point about feedback made in the above section
- The ability to edit the generated data –there will inevitably be some anomalies that require adjustment
- The output file produced follows the OneLilly formal input specification. This specification can be found in Appendix A: Section 2.

However, there are pieces of functionality that confuse users, and have the potential for improvement:

- The cross-reference table easily confuses users. This is because old data values remain within the table and new values are placed below this (rather than ignoring if the record is already present) –this problem must then be resolved manually.
- Old data should be removed before the tool can be used with new data. This has the following implications:
  - The corollary of the above problem is that it is not possible to see data from previous uses of the tool if it is being used as specified. The current work-around is to rename tables to allow for data retention; however this causes problems with relational integrity, and thus is not deemed a reliable mechanism.
  - It is not possible to compare data generated with a given run of the tool to data generated previously. This was being noted as useful in investigating errors in generated data.

Users commented on the robustness of the tool, noting that it is easy to break. Some of the comments included:

- Incorrect results are produced for some values because of inflexible or incorrect SQL.
- If any tables or queries are re-named to preserve old data, relational integrity of the data is compromised, and thus incorrect output can be generated.
- It is possible for any user to delete any table or query.
- The tool has no security and can be edited by anyone (since it is located on a shared server).

In the next section a summary of the findings is given.

3.3.5 Summary of findings

The crux of the suggestions made about usability can be summarised as follows:

- Removing the visible SQL code and enabling the entire process to be carried out through a graphical user interface.
- Navigational assistance is required.
- The current tool is only suitable for experienced users this limited its uses and can hold back deadlines if specific users are away. Therefore it is important that the new systems includes user guidance at all appropriate points such that a non-experienced user is able to use the tool
  - Include guidance through the task, possibly having a bar across the top informing users of the stage they are currently at (like shopping online checking -> payment).
  - Include online help facilities throughout the tool. Enable a user to get context-sensitive help if they desire.
  - Include training videos illustrating how to complete various tasks for users who desire this.

Suggestions for new features can be summarised as follows:

- Include the ability to complete the necessary tasks for all sales forces within one tool rather than having multiple instances.
- Improve output options, for example sending generated data directly to the server where it is used.
- Provide the ability to save work in progress and return later to a task.

- Provide the ability to keep an audit trail of what data was sent to OneLilly and by which user.
- Where possible prevent free-text entry and potentially only allow specific users to edit static fields.
- Provide key statistics about generated data upon completion of the process, this could include a record count for:
  - Each data type
  - Invalid records
  - Each division
  - Each sales force

Suggestions and comments about maintainability and support can be summarised as follows:

- Allow the output file specification to be easily modified to accommodate new software releases.
- Either integrate the tool with 'Lilly single sign on' (the standard log-on for all systems across the Lilly environment) for authorisation purposes, or implement a proprietary login system and support tools for the tool.
- User control of data versus the likelihood of breaking the tool.
- Deployment – installation on a shared server is preferred than deployment to multiple machines. All standard office machines run Internet Explorer V7.

Now interviews are complete the next part of the data gathering process is to complete a heuristic evaluation of the existing tool.

3.4 Heuristic evaluation of the existing tool

As part of the requirements analysis for the new tool, it is important to identify the underlying usability problems with the existing system. As discussed in chapter 2, there are a variety of techniques for evaluating an interface. Heuristic evaluation is an informal method of usability analysis whereby evaluators are asked to comment on the design within a defined framework. A HCI expert was asked to complete this evaluation.

Interview with: JC

JC is completing an MSc in Human Communication and Computing at the University of Bath. JC has experience in the pharmaceutical industry as well as completing a dissertation within the HCI field.

Method: The HCI expert was presented with the system and asked to perform the task following the same instructions provided to a user. A copy of these instructions can be found in Appendix A: Section 3.

A concurrent protocol was provided by the HCI expert whilst working through the task, identifying well and poorly designed features. His comments were then categorised using Nielson's set of heuristics (see section 2.3). Notes were taken throughout the interview. These can be found in Appendix A: Section 4.

The most discussed heuristic was visibility of system status. On numerous occasions whilst the HCI expert was using the system it failed to provide him with any feedback. Important episodes or events were identified as including completion of a query, which if re-run by mistake could result in incorrect data. Jason advised that a confirmation prompt should be displayed prior to

commencing a long or critical action task and the user should be aware when the task has completed, for example the results could be displayed before a user is returned to a main page.

The lack of clearly defined start- and end-points have a negative effect on the usability of the existing tool, and the lack of guidance means that it is not possible for a user to follow a path to their goal. These combine to reduce user awareness of the system state, resulting in users needing to constantly refer to paper-based documentation in order to achieve their goal.

The lack of a match between the tool and the real world was discussed in detail. One particular example which was highlighted is that users are unable to see what data is being removed prior to removal since they are required to write an SQL query to delete rows. This is a concept that is not familiar with non-technical users - it should match the real world in terms of viewing, selecting and deleting data through an interface.

The system also displays a number of message prompts which are meaningless to most users. Figure 8 shows one particular example.

Figure 8. An Example of a Message Prompt

The 'help' button provided no further assistance on which option should be chosen. Nielson's heuristic states the system should use words and phrases with which users are familiar. Adopting this principle will lead to a reduction in errors encountered.

Neilson's tenth heuristic states that whilst it may be better that a system can be used without online documentation, if it must be provided it should be simple to search, task-focused and easily navigable.Currently, users need to follow written documentation precisely to ensure tasks are completed successfully. However, the documentation makes assumptions about what experience of Microsoft Access a user may have. The documentation of the existing tool fails to provide a complete guide to the steps that must be taken to achieve a desired goal, with large sections missing.

Finally, an interesting conversation arose during the interview regarding system icons. Access is standard software, thus the main icons may be familiar to some users, but the HCI expert discussed how they could be used more appropriately. See figure 9 for an example, the image shows different query types and their corresponding icons.

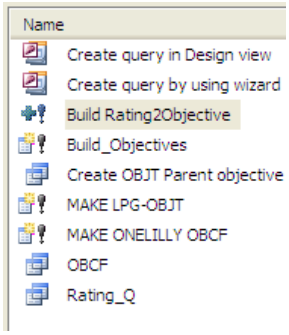


Figure 9. An Example of Query Icons

The first thing to note is whether or not the icons give an accurate reflection of the associated activity associated with it. Where possible icons should be based on existing traditions or standards. However, care should be taken not to confuse users by using a standard icon where a non-standard activity is likely to be performed.

An example of this is the "append query" icon (third from the top). Upon first examination, and without knowledge of the icons Microsoft Access uses, it would be natural to assume that a plus sign means creating a completely new data set, rather than appending to an existing one.

It was pointed out that this particular screen could have been improved through grouping queries by type rather than ordering them by name. This is especially important since some query names can be very similar. Now that the initial data gathering phase is complete it is now possible to begin modelling, this is done using task analysis.

3.5 Task Analysis

As stated in chapter 2, a task analysis is used to establish a foundation of existing practices on which to build new requirements. It is therefore essential to understand how the task is currently completed. Data can be collected by an observation of the current task, and this is completed in section 3.5.1.

From the interview comments and initial discussions it is clear that the users still revert to their understanding of the previous manual solution, the comments raised by the users suggest that there is a potential issue with how the task flow is structured differently between the two solutions. Thus it is important to not only focus on the existing solution but to investigate this task sequencing issue also from the past experience of users. This analysis will take place by using a card sorting session to allow users to pictorially show their task sequencing preferences, this is completed in section 3.6.

Once this data has been collected it will be possible to complete an analysis to look for the similarities and differences between the two solutions and make informed decisions on which processes new requirements can be built from. Completing a hierarchal task analysis of each of the solutions will model the sequencing enabling easier comparison and this is completed in section 3.7.

3.5.1 Observation

Completing an observation will allow an initial assessment of the usability of the tool, to do this a user who has never used the tool before was requested to complete the task and a record was made of where the user experienced issues. Due to the complexity of this tool this would only be useful if an experienced user firstly gave a demonstration of how they complete the task.

The task will be to generate objectives data for one sales representative from the LPG (Lilly osteoporosis group) sales force. Typically, the tool would be used to generate data for an entire sales force and therefore approximately 100 sales representatives, so it is important to note some areas of the tool will be simplified, for example the cross reference.

The evaluation session will be recorded using a Dictaphone supplemented by hand-written notes.

Background of participants

The experienced user has been using the tool in question since it was developed, and will assist and demonstrate the tool to the inexperienced user. She has acquired the required technical skills; however they are not a requirement for her job role.

The inexperienced user has never used the tool. She has a basic understanding of the objectives data as she has assisted with the task before the adoption of the existing tool. She does, however, use Microsoft Access for other tasks and consequently some of the concepts are familiar.

Results and analysis

The experienced user took around 20 minutes to complete the task, in contrast to the inexperienced user, who took approximately one hour. It is reasonable (based on past experience) to assume that these figures would be doubled with generating data for all sales representatives in a sales force because additional actions and verification checks would be required.

Both users relied on the step-by-step guide (which can be found in Appendix A: Section 3); although it was observed that this guide is not an accurate reflection of how the task is completed, as it does not document workarounds for functional problems.

Figure 10 shows a summary of the task with steps labelled on the diagram and then referenced within the text.

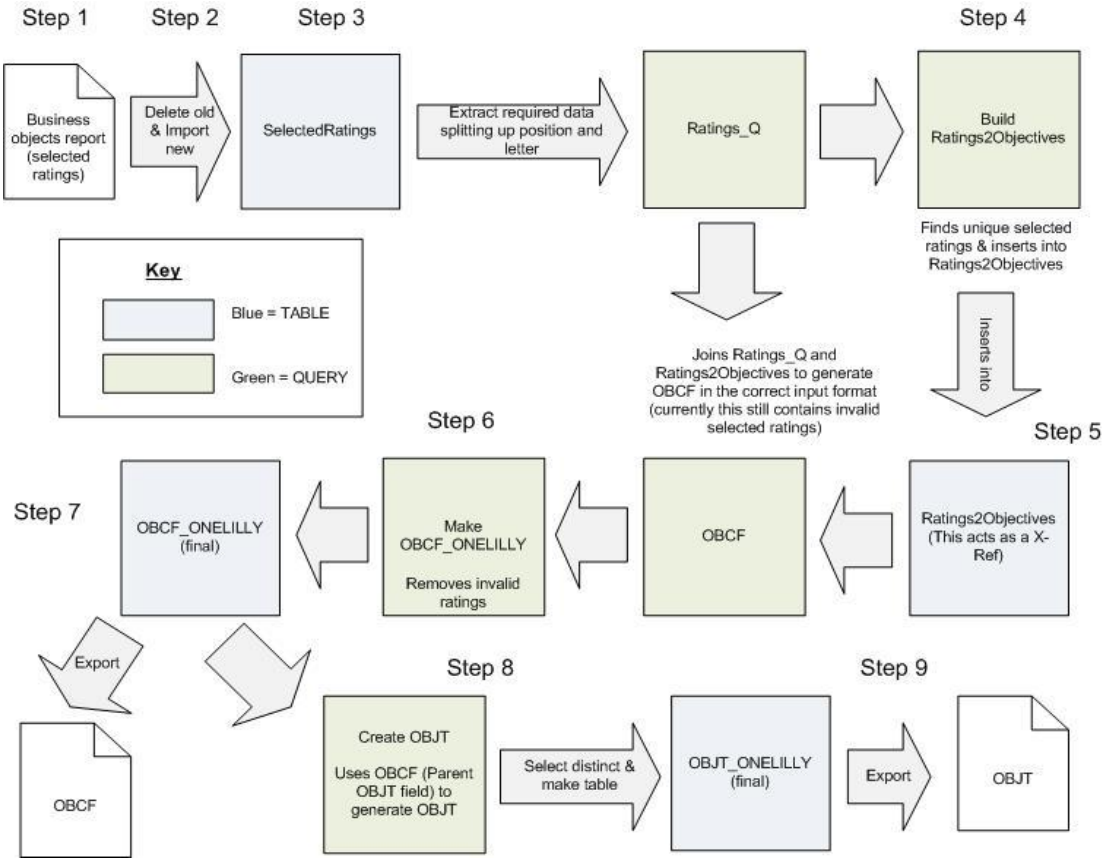


Figure 10. Overview of the Targeting Process

In the following descriptions, italic text describes how the inexperienced user approached each step.

STEP 1 - Generate the business objects report, taking the data from the global CRM system. The purpose of this is to extract the rating that each sales representative has selected for each health care professional).

A sales representative will give each of their customers a 'rating', which determines how each of their customer's are targeted for particular drugs.The rating is selected by each sales representative from a drop-down box within the CRM system, and has a value taken from the following values: A+, A, B+, B, C+, C and Non-Target.Each letter refers to a particular rating which may be different for each sales force. Figure 11 shows the notation used for the LPG sales force.

For each target customer a value needs to be entered in the 'My Selected Rating' field:

- **A** = Zyp-Sch Only
- **A+** = Zyp-Sch+ Cym-Dep
- **B** = Zyp-Bip Only
- **B+** = Zyp-Bip + Cym-Dep
- **C** = Cym-Dep Only
- **C+** = Zyp-Sch + Zyp-Bip
- **Non Target** = Zyp-Sch + Zyp-Bip + Cym-Dep

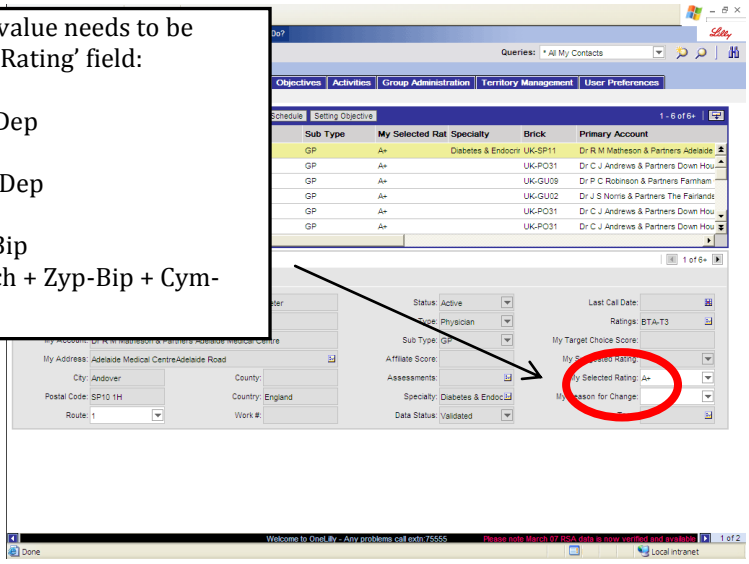


Figure 11. Notation used for LPG Sales Force

Zyp-Sch refers to Zyprexa[1] for the purposes of treating schizophrenia. Zyp-Bip refers to the same drug for use in treating bipolar disorder. Cym-Dep refers to Cymbalta[2] for the purposes of treating some forms of depression. This coding system forms the 'cross-reference' which has been mentioned during interviews.

The generation of the business objects report is completed outside the targeting system, since it is a separate application. For the purposes of this observation the report was already generated and provided to the inexperienced user.

As the inexperienced user was introduced to the tool, she commented on the fact that data was not produced in a logical order. Referring back to Figure 3.2,data was generated from the "top-down" when performing the task manually, whereas with the current tool flow begins with loading and generating data for the call frequency and then working from the "bottom-up" to create the targeting data.

The sequence of tasks not following that of the manual system was also raised during the interviews; the current tool has a very strict sequencing of tasks with little flexibility. These comments, along with Nielson's third heuristic of 'user control and freedom' have highlighted a usability issue and will be used in forming new requirements.

[1] A Lilly drug used to treat a range of mental disorders, including schizophrenia and bi-polar disorder.
[2] A Lilly drug used for treating depression

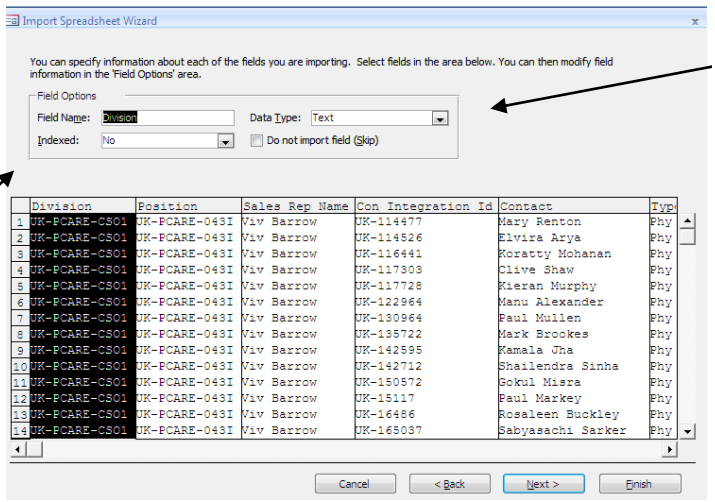
STEP 2 - Deleting old data and importing new data from the provided business objects report. The experienced user explained that she prefers to keep previous data, so she renames the table containing the previous data rather than deleting it.

New data is then imported by 'Import' command on the 'File' menu and following the wizard, ensuring the destination table name is 'SelectedRatings'. This provides a point of failure, since an incorrectly named table will produce incorrect data, or not work at all.

The inexperienced user commented that it was difficult to find which table to rename when following the step-by-step guide. Help was provided to enable her to do this correctly. She noted that some guidance within the tool would have made this easier. Whilst following the import wizard, the user had to ask for assistance as she was unclear on which options to choose. She commented that although the wizard (as shown in figure 12) provided some guidance, it was general rather than specific to her task.

The user described how she remembered being told about column headers and could not remember whether it should have been edited here.

Neither of the users understood what 'Indexed' meant, so just ignored this option.


Import Spreadsheet Wizard
You can specify information about each of the fields you are importing. Select fields in the area below. You can then modify field information in the 'Field Options' area.
Field Options
Field Name: Division
Data Type: Text
Indexed: No
Do not import field (Skip)
Division Position Sales Rep Name Con Integration Id Contact Typ
1 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-114477 Mary Renton Phy
2 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-114526 Elvira Arya Phy
3 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-116441 Koratty Mohanan Phy
4 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-117303 Clive Shaw Phy
5 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-117728 Kieran Murphy Phy
6 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-122964 Manu Alexander Phy
7 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-130964 Paul Mullen Phy
8 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-135722 Mark Brookes Phy
9 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-142595 Kamala Jha Phy
10 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-142712 Shailendra Sinha Phy
11 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-150572 Gokul Misra Phy
12 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-15117 Paul Markey Phy
13 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-16486 Rosaleen Buckley Phy
14 UK-PCARE-CS01 UK-PCARE-043I Viv Barrow UK-165037 Sabyasachi Sarker Phy
Cancel
< Back
Next >
Finish

The user commented that the field 'Sales rep name' is not required in the final objectives data so why is it being imported? The experienced user commented that it is imported (for ease of use, since it is already within the business objects report) but is ignored in the rest of the tool.

Figure 12. Prompt for Importing Data

The need for user guidance was raised during the interviews. Again, this features in Nielson's heuristics, and will be taken into account when forming new requirements.

STEP 3 - Because the Business Objects report is not always in the same format, it is important to check that the imported data has the same columns as the existing table. This is made easier by retaining previous data. All columns must be the same, since queries refer to specific fields. The experienced user demonstrated how she would correct it if the fields did not match, which required her to use the design view for the table.

The inexperienced user forgot to complete this step as it was not on her guide sheet. Consequently the next step failed and the tool displayed the prompt shown in figure 13, which did not help the user diagnose the problem.

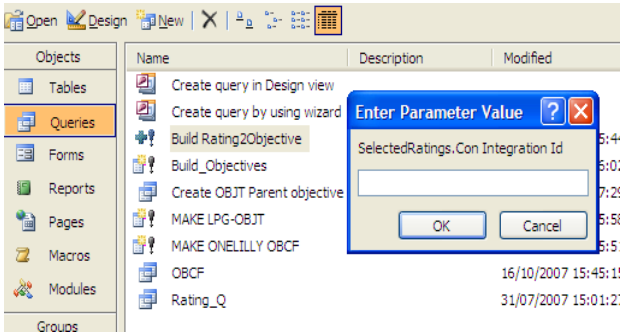


Figure 13. Prompt Displayed after A Query has ran

Discussions with the users determined this step should not exist as it was put in place as a workaround for an unstable Business Objects report. This has now been corrected and produces data in the correct format each time it is run. This observation highlights the need to ensure that informative messages are meaningful and useful. Nielson's heuristic 'help users recognize, diagnose, and recover from errors' should be followed such that users are able to recover using only the guidance given in error message.

STEP 4 – This step involves running the 'buildRating2Objective' query, which builds the cross-reference table. It works by selecting unique values of selected rating from the imported data, and is required because the global OneLilly application from which the data originates contains a free text field, enabling sales representatives to enter values which are not already in the cross-reference. The query appends all values to the cross-reference table, even if they already exist, as noted during user interviews.

The inexperienced user had difficulty locating the required query. After receiving help finding the queries window, she noticed it was easy to run any query, and thus asked for confirmation that she was indeed about to run the correct one. Upon running the query, the user was presented with the prompt shown in figure 3.9, and required assistance on the corrective action to take. Had the user not received this assistance she would have been unable to continue. She was guided back to completing the previous step, enabling her to complete step 4 successfully.

This observation again highlighted problems with navigating the current tool. Although tasks need to be completed in a precise order for the tool to succeed, it gives the users freedom to complete them in any order. It also highlighted the lack of information on how to proceed, especially if problems were encountered. Section 2.3.1 of the literature review discussed navigational design and suggested that each screen of a system should give the user enough information to allow them to move closer to their goal.

Another problem that was highlighted during this step is that of the current tool adding duplicate values to the cross-reference table. All of these observations must be taken into account when forming the requirements specification and for a new system.

STEP 5 - This step is to update the cross-reference table. The user explained that this step is important to ensuring that generated data are correct. Figure 14 shows a completed cross-reference table.

Rating2Objective : Table

ID	FF_POSTFIX	Rating	Objective	Product	Indication	Objective parent
1	R	A	Zyp-Sch	UK-ZYPREXA	Schizophrenia	Zyprexa-S
9	R	A+	Cym-Dep	UK-CYMBALTA	Depression	Cymbalta
2	R	A+	Zyp-Sch	UK-ZYPREXA	Schizophrenia	Zyprexa-S
3	R	B	Zyp-Bip	UK-ZYPREXA	Bipolar	Zyprexa-B
10	R	B+	Zyp-Bip	UK-ZYPREXA	Bipolar	Zyprexa-B
4	R	B+	Cym-Dep	UK-CYMBALTA	Depression	Cymbalta
5	R	C	Cym-Dep	UK-CYMBALTA	Depression	Cymbalta
11	R	C+	Zyp-Bip	UK-ZYPREXA	Bipolar	Zyprexa-B
6	R	C+	Zyp-Sch	UK-ZYPREXA	Schizophrenia	Zyprexa-S
7	R	IS NOT NULL	INVALID	INVALID	INVALID	INVALID
13	R	Non-Target	Cym-Dep	UK-CYMBALTA	Depression	Cymbalta
12	R	Non-Target	Zyp-Bip	UK-ZYPREXA	Bipolar	Zyprexa-B
8	R	Non-Target	Zyp-Sch	UK-ZYPREXA	Schizophrenia	Zyprexa-S
(AutoNumber)						

Figure 14. Cross-reference table

Running the 'buildRating2Objective' query in the previous step, the following fields in the cross-reference are filled in automatically:

- ID: This field is used only for internal purposes.
- FF_POSTFIX: This is used to distinguish between different types of sales representatives within a sales force (In this particular example R is used for 'UK-LPG-RSP' Appendix A: Section 5 shows example positions and wish sales team they belong to).
- Rating: This field contains the unique ratings from the imported data. In this example the value 'IS NOT NULL' appeared. The cause of this was a sales representative entering data mistakenly whilst attempting to query. Setting all other fields to 'INVALID' prevents this error being passed through to the final files.

The remaining fields must now be completed by the user:

- Objective: This field should contain the objective represented by the rating (as previously seen in figure 11). In this example the rating A+ appears twice, as this letter indicates that a customer will be targeted for both Zyprexa and Cymbalta.
- Product: This field should contain the product identification for the given rating, which must match the identifier used in global OneLilly application. It is possible that the user can enter any value, so the user must complete an extra check to ensure no mistakes have been made.
- Indication: This is the illness at which the given objective is targeted. For example, the objective Zyp-Sch has the indication Schizophrenia. Again, it is possible for the user to enter any value, meaning an addition check for errors must be completed.
- Objective parent: This field is used to form part of the objective name (as seen in the second layer in figure 6). More information on how the objective parent forms part of the targeting data was discussed in section 3.3.

Further discussions with the user made it apparent that it is possible for the final three columns to be derived from the objective field; therefore users should not need to manually enter these values.

When the inexperienced user reached this step she was immediately confused by the additional rows added. She received help to understand which ones existed already and thus could be deleted. The experienced user discussed how she normally sorts on the position letter; however this was not necessary since only with one sales representative is being used here. Once the user was familiar with which fields required updating, she successfully completed and saved the cross-reference table.

Another comment raised here was about the layout of the table. She discussed that she thought having two records for multiple objectives for one rating was confusing. She suggested that she would like the system to follow her thinking - "being able to add another objective to a rating

rather than having the same rating with a different objective". Finally there was a discussion around user guidance and assistance to aid the user in completing this cross-reference.

It was decided that the new system should allow the cross-reference table to be sorted by any column. Since there is no need for the user to view the ID column, this should not be visible to them, and fields requiring specific values should use drop-down boxes. The user has requested that automatically generated fields still be visible to them.

STEP 6 – This step is to delete the previous OBCF_ONELILLY table. However, the user prefers to rename it and then run the 'Make OBCF_ONELILLY' query to generate all records for the call frequency objectives. The user commented that if she is generating data that is not for the fourth quarter, she has to edit the SQL code (since it is 'hard-coded' and so preset to Q4).

For the example used in this observation, the data was for the fourth quarter. However, the inexperienced user commented that had it been for another quarter she would have been unable to complete the step since she has never worked with SQL previously. It is also useful to note that both users said that they do not read the message boxes that are displayed before the query runs, commenting that either they did not understand them or the messages were uninformative.

At this stage the users discussed how they rename the table to enable them to save the previous data. This was also discussed during the interviews. They stated that the reason it is desirable to save previous data is because it can be used to check the generated data, helping them verify that the query ran correctly, and that this functionality should be maintained in a new system.

A new system should be entirely GUI-based, and not allow users direct access to queries. This means that there will be a requirement to select for which quarter data is being generated.

STEP 7 - This step is to perform high-level checks on the generated OBCF table in order to look for significant problems with the data. The user describes it as "giving her a sense of security that the tool has completed what it is meant to".

There are two checks carried out by every user at this stage:

1. Ensuring that the divisions correctly correspond to the positions. For example, positions ending in the letter "R" must have the division "UK-LPG-RSP". This is done by sorting on the position field and completing a visual check.
    - It is useful to note here that this check was completed before the current tool existed, and in the time since then, the data has been consistently correct. It is possible that this check is therefore being completed out of habit rather than necessity.
2. Ensuring that the OBCF data is as expected for each rating. This is achieved by checking that each type of selected rating from the original file has translated into the correct objectives in the generated file.

The inexperienced user had difficulties locating the table that the previous query had generated, and thus was unable to check it. After receiving assistance to locate this, there were no further problems.

It was requested that anew system still allow users to complete these checks should they wish. This can be achieved by allowing users to sort on columns and search for specific values within the data.

STEP 8 - This step involves generating the objective parent records (OBJT) and verifying them. The 'Make OBJT_ONELILLY' query creates a table named 'OBJT', which must be verified. Verification is performed by sorting the table on position division and then completing the following checks:

- The position names correspond to the position division
- The start and end dates correspond to the name of the objective
- The business plan corresponds to the correct position name

The user also takes a random selection of the business plans and checks that a business plan record exists either within the global OneLilly application or is contained in the business plan data currently being generated.

She also commented that because of experience of creating objectives data she usually estimates the number of records expected to be in the OBJT table, providing a useful guideline for ensuring the data is correct.

During the observation there were no problems with the generated data, so the user explained why she completes the checks, and that although problems rarely occur, the checks are still completed for her peace of mind.

The inexperienced user was unable to locate the correct query to run, as the name did not match the one given in her guide. Upon receiving assistance to locate the query she successfully verified the table.

A new system must allow users to complete these checks if they so wish – it is anticipated that a similar method as described for the previous step could be used.

STEP 9 - This step is to export both the OBJT and the OBCF tables and prepare the final file for loading into OneLilly. The user explained that she uses the "Export as .xls" such that she can process the data further in Excel.

A print screen of the Excel template used to combine all data types is shown in Appendix A: Section 7.It consists of a worksheet for each data type, and a further worksheet containing command buttons for completing verification checks on the data. It also contains a worksheet for sales quota data (OBSQ), which is generated in the required format externally to the targeting process. It is verified and exported along with the rest of the data however. The corresponding OBJT records for the sales quota data are appended to the records exported from the targeting tool.

When all data has been imported and verified, "Export" button is used to format the data for loading into OneLilly. The user is informed of the location in which the generated file is placed. Two final verification checks are performed prior to data loading:

- That the expected number of records appears in the file
- That the end character is present at the end of every record

The inexperienced user used a different method to export the tables, as she has previous experience of Microsoft Access. The remaining steps were completed as expected.

It was decided that a new system should allow for this step to be removed. Users should import the sales quota data, and all verification checks should be completed within the system. It was, however, requested that it be possible to export the data in the Microsoft Excel format or view the final file in the format it is as sent as. This will enable users to complete any remaining checks they wish as well as enabling them to retain all data files produced.

3.5.2 Observation summary

Observing users with the existing tool has given an insight into the targeting process and has highlighted the following things:

- The users relied heavily on the step-by-step guide and were confused when it did not correspond to the tool.
- Navigation of the system was a problem for the inexperienced user.
- Messages boxes or prompts are often ignored as they are not understood or do not contain relevant information
- The task depends on the cross-reference table being completed properly, but this is a complex task with which users struggle.

It is clear that users of the existing tool rely on their understanding of the manual system that was in place prior to it, and the fact that task order is different means that their knowledge does not directly map onto the tool. Consequently an analysis of the difference in task flow between the two solutions will now be completed.

3.6 Card sorting session

Because the targeting process is so extensive and flexible, it was decided to scope this session to deal purely with generation of business plan data. Each participant was asked to compile a list of the steps required to complete the BSPL data prior to the session.

An informal discussion session was then held to enable participants to compare, describe and discuss the reasoning behind their choices.

Three users with various levels of experience with the task participated in the session. One of these was the primary user who also participated in the observations documented previously.

3.6.1 Results and analysis

Each participant produced a different ordering of tasks. Immediately, each user stated how flexible the manual solution was and how each time they complete the task they alter the task flow. Although it is important to note that the ordering of steps was different, each user undertook exactly the same steps.

After the initial discussion the first part of the session involved producing a post-it note of each step and allowing each participant to arrange them in their preferred order. Notes and pictures were taken from each of the user's choice. Figure 15 shows the first user's result.

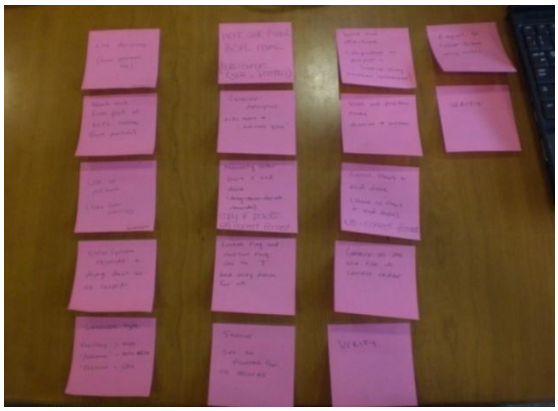


Figure 15. User's Results from Card Sorting Session

The users described how they used an Excel template with column headers set out as the formal specification shows (the specification can be found in Appendix A: Section 2). To a certain extent it is then the user's choice on the ordering of which fields they decide to complete.

The first user arranged her cards as follows:

1. In a separate spreadsheet import the sales representative data from OneLilly.
2. Divide the number and letter from each position using a formula
3. Within the template:
4. For the number of records required enter the 5 **System Fields**
5. For each record generate the **Type** based on the position
6. For each record use a concatenation formula to complete the BSPL **Name** based on the date range, type and position from the initial spreadsheet
7. Generate the **Description**(a concatenation of name field and "Business plan")
8. Enter the **Start Date** and **End Date** in the correct format
9. For each record enter 'Y' for the **Locked flag** field
10. For each record enter 'Y' for the **Position flag** field
11. Set S**tatus** to 'Planned' for all records
12. For each position list the **Position Division***(sales force)*
13. For each record generate the **position name***(This corresponds to each sales representative, data is taken from the initial spreadsheet)*
14. Complete the **Local Start Date** and **Local End Date**
15. Complete a manual check to ensure values are correct
16. Verify data using the provided macros
17. Export using the provided macro
18. Verify final load file

Following this initial ordering, the other users re-arranged the cards to represent their routes through the task. The steps taken by the other two users were as follows:

User Two: 1, 2, 4, 5, 7, 11, 6, 13, 12, 10, 8, 9, 3, 14, 15, 16, 17

User Three: 3, 10, 8, 9, 7, 13, 1, 2, 4, 5, 6, 11, 12, 14, 15, 16, 17

The discussion of the reasoning behind these choices highlighted the following points:

- The independent steps are 3, 7, 8, 9, 10 and 13
- Steps 14-17 are completed at the end of the process by all users.
- Steps 1 and 2 must be completed before any other step that is not independent, since they provide the basis for completing other fields.

During the discussion the users stated that although they had given their preferred ordering of tasks they do vary them. Initial solutions reflected much flexibility but this was due to the amount of manual data entry required. When this was replaced with automation within the Access application, those steps were removed meaning the flexibility had been lost.

The new system will also contain automation, meaning many of the steps listed in this card sorting session will no longer be required. The reason for completing this is to understand how much flexibility the users require and the level of desired flexibility in the new system should have. As this session has shown the user is aware that some steps need to be completed prior to others can, in the Access solution users found it more difficult to know the exact ordering without referring to the paper-based guide. After discussions with the users it was clear that the

new system should maintain some flexibility in terms of preparing the data but the new system should prevent errors such that it does not allow a user to proceed to another step if there is a pre-requisite. Using the results from the observation and card sorting session it is now possible to model task within a hierarchal task analysis.

3.7 Hierarchal Task Analysis

The CARD session has provided a useful insight into the flexibility of the task flow for the previous solution, it is now important to bring together both the observational findings and the card sorting session to enable us to analyze the underlying rationale and purpose of what the users are doing. This will provide an informed basis for the new system.

As discussed in section 3.6 creating a HTA for each solution will be of benefit such that the two models can be compared to find similarities or differences that need to be taken forward into the new system.

The first manual solution has an extensive number of steps, therefore the HTA will exemplify detailed steps for just one record type, the remaining will display the high-level tasks only.

Figures 16 and 17 show the HTA for each of the solutions.

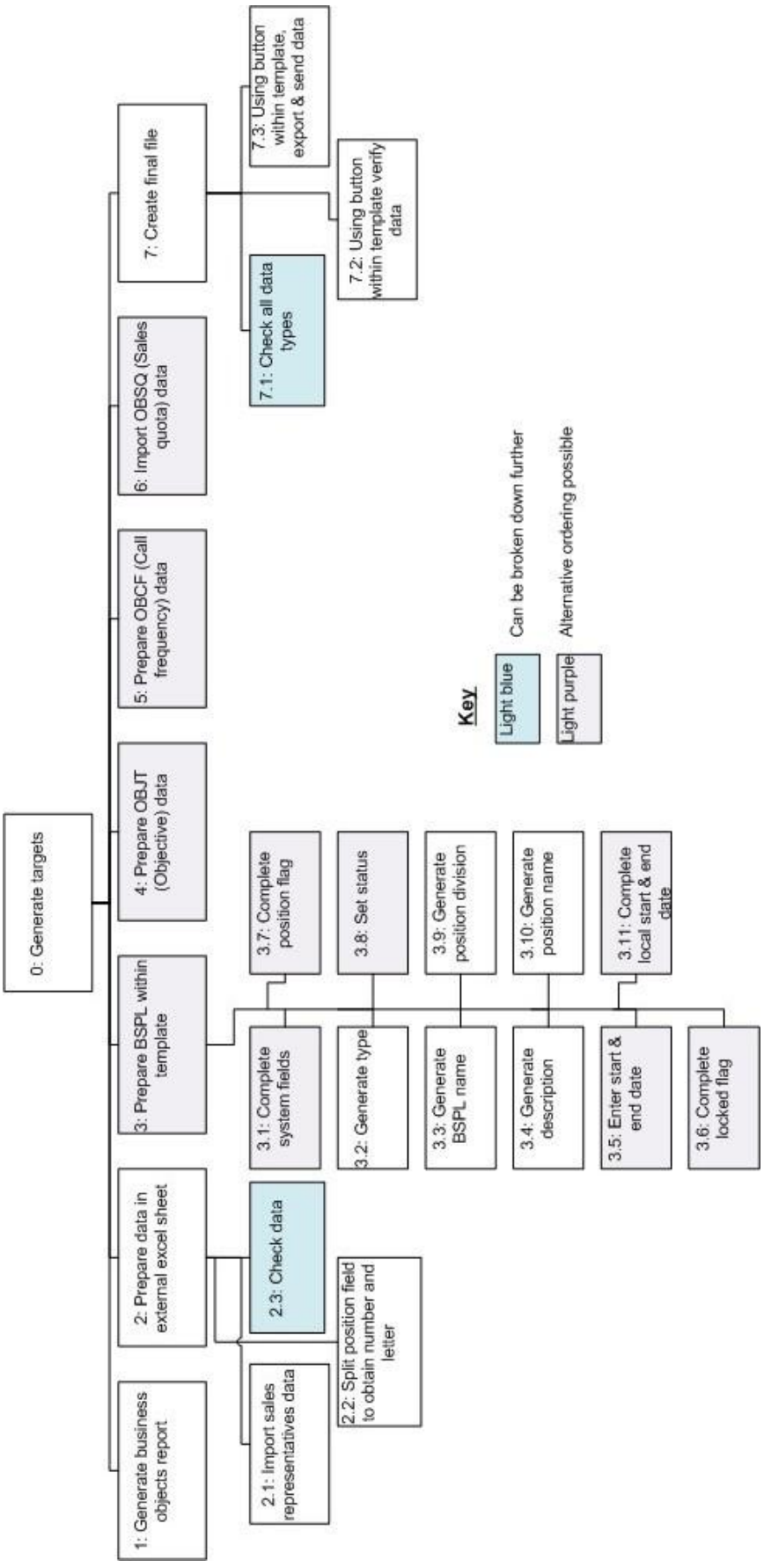

0: Generate targets
1: Generate business objects report
2: Prepare data in external excel sheet
2.1: Import sales representatives data
2.2: Split position field to obtain number and letter
2.3: Check data
3: Prepare BSPL within template
3.1: Complete system fields
3.2: Generate type
3.3: Generate BSPL name
3.4: Generate description
3.5: Enter start & end date
3.6: Complete locked flag
3.7: Complete position flag
3.8: Set status
3.9: Generate position division
3.10: Generate position name
3.11: Complete local start & end date
4: Prepare OBJT (Objective) data
5: Prepare OBCF (Call frequency) data
6: Import OBSQ (Sales quota) data
7: Create final file
7.1: Check all data types
7.2: Using button within template verify data
7.3: Using button within template, export & send data
Key
Light blue
Can be broken down further
Light purple
Alternative ordering possible

Figure 16. HTA for the original solution

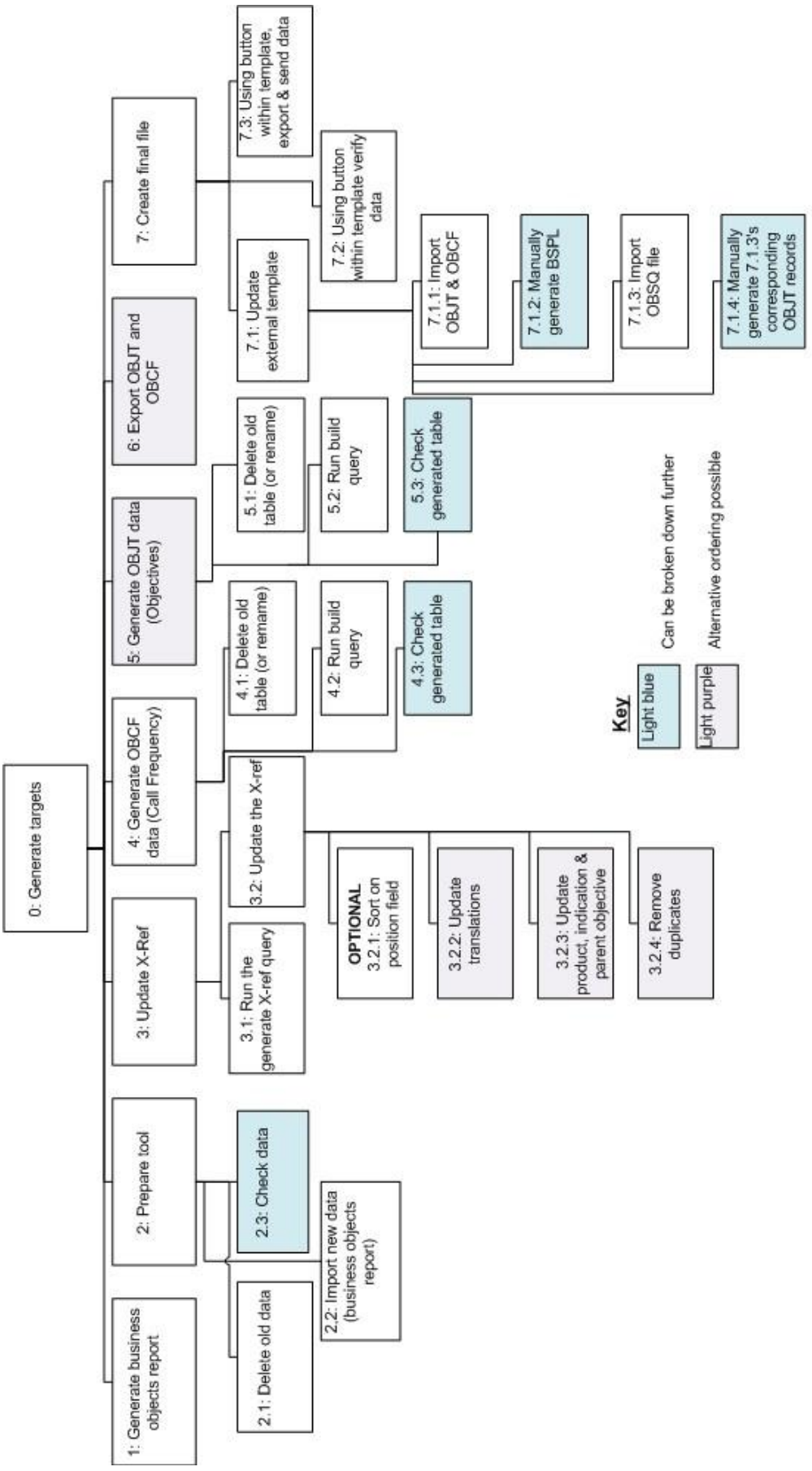

0: Generate targets
1: Generate business objects report
2: Prepare tool
2.1: Delete old data
2.2: Import new data (business objects report)
2.3: Check data
3: Update X-Ref
3.1: Run the generate X-ref query
3.2: Update the X-ref
OPTIONAL 3.2.1: Sort on position field
3.2.2: Update translations
3.2.3: Update product, indication & parent objective
3.2.4: Remove duplicates
4: Generate OBCF data (Call Frequency)
4.1: Delete old table (or rename)
4.2: Run build query
4.3: Check generated table
5: Generate OBJT data (Objectives)
5.1: Delete old table (or rename)
5.2: Run build query
5.3: Check generated table
6: Export OBJT and OBCF
7: Create final file
7.1: Update external template
7.1.1: Import OBJT & OBCF
7.1.2: Manually generate BSPL
7.1.3: Import OBSQ file
7.1.4: Manually generate 7.1.3's corresponding OBJT records
7.2: Using button within template verify data
7.3: Using button within template, export & send data
Key
Light blue
Can be broken down further
Light purple
Alternative ordering possible

Figure 17. HTA for the Access solution

Note that step 7.2.1 in figure 14 can be divided and these steps are shown in step 3 of figure 13. This is a large number of steps and after discussing these further with the users it became apparent that these steps could also be automated. Therefore the new system should treat the business plan data creation just as the objectives and call frequency whereby the user will complete checks rather than manually enter each field's value. This is a fundamental shift in user to system functional allocation.

It is also useful to note that the final stage of both of these solutions was completed externally to the application the rest was completed within. This was discussed with the users and it was found that they consider this step to be time consuming and it is also another opportunity for an error to occur when transferring data. It would improve the overall efficiency and user experience if this step could be part of the new system, this again is another functional shift to the system from the user.

As highlighted earlier there is still a concern with the ordering of data production with reference to figure 6, the number of steps where an alternative ordering is possible is significantly higher in figure 13. This concern does need to be considered when designing the new system; if it provides flexibility then it will be a user's choice on whether they wish to work on data top-down or bottom-up.

3.8 Setting priorities

The next stage is to discuss the findings from this phase with the stakeholders prompting them to consider the priorities of the problems identified.

3.8.1 Main priorities

As requested by users during interview sessions:

- Ability to export all file types to Excel
- Little or no training should be required for the usage of the new targeting system
- Provide navigational assistance to the user
- The application should have appropriate security such that only OneLilly team members have access
- Remove all visible code from the user
- Preventing users from updating table structures and queries
- Improve the usability of the cross-reference table
- Prevent duplicated data being inserted into the cross-reference table
- Provide users with feedback, particularly when invalid data has automatically been removed

3.8.2 Secondary priorities

Users made the decision to place these items as secondary priorities because they do not form part of the core functionality supporting the task.

- Verification of final data set
- Exporting final file directly to the required server
- User roles with the functionality to add new users and update their role

- Saving the current state and when logging back in being returned to that particular users last state
- Providing detailed statistics
- Provide user guidance throughout the task

3.9 Project scope

The benefits of the new OneLilly targeting system will include increased navigational efficiency, improved business processes such that all tasks are completed within a single application and an easier-to-use interface requiring no technical knowledge. These benefits will then lead onto increasing the number of potential users and overall productivity of the targeting process. The aim of the project is to produce a working prototype of the OneLilly targeting application; this can be satisfied by developing the application for a single sales force within the UK (this will be LPG).

Section 3.4.4 of the interviews highlighted some concerns for viewing previous data and keeping an audit trail of previous data that has been produced. Importantly, the aim is to develop a new usable interface rather than auditing functionality, so this is not a major concern since stakeholders stated that this can be fulfilled by allowing a user to save every file produce and storing the file elsewhere.

3.10 Requirements specification

In software engineering two types of requirements have typically been identified: functional, what the system should do and non-functional, the system properties and constraints. Non-functional requirements cover a broad range of different requirements types consequently Preece et al [2] proposed dividing them further into categories as follows:

- ***Data requirements**:* capturing the type, volatility, size/amount, persistence, accuracy and value of the amounts of the required data.
- ***Environmental**:* referring to the circumstances in which the interactive product will be expected to operate, these include the physical, social, organisational and technical environments.
- ***User requirements**:* capturing the characteristics of the intended user group.
- ***Usability requirements**:* capturing the usability goals and associated measures for the new system.

These categories will be used to define the requirements for the new OneLilly targeting system. Preece et al [2] states that "One of the aims of the requirements activity is to make the requirements as specific, unambiguous, and clear as possible", to ensure the requirements specification follow this they will follow the Volere process (Robertson and Robertson, 1999), the template suggested includes the following:

- ***Requirement number**:* to uniquely identify the requirement
- ***Description**:* a statement of the intention of the requirement
- ***Rationale**:* an explanation as to why the requirement is necessary
- ***Source**:* where the requirement was raised

The listed requirements will follow the common convention for distinguishing between mandatory and desirable requirements, the word 'shall' for mandatory and 'should' for desirable.

Functional requirements

1. **The system shall only allow the UK OneLilly team members to access the system**
   Rationale: This is required to prevent unauthorised employees to accessing the system and potentially viewing confidential information. Security is not a main concern for this project and if this prototype were to be taken further Lilly would integrate this with their sign-on system. Therefore the login functionality should be kept simple, with the key requirement being usability.
   Source: The need for security was raised during the interviews (section 3.3).

2. **The system shall have an administration area that enables objectives and their corresponding fields to be updated**
   Rationale: During the observation we learnt that allowing the user to enter free-text will cause errors to occur, to prevent this from happening it will be replaced with a drop-down box which requires administering.
   Source: Step 5 of the observation (section 3.5.1).

3. **The system should only allow specific users access to the administrator area**
   Rationale: As discussed in requirement 2 allowing free-text entry causes errors, this can be prevented by allowing only specific users to update objectives
   Source: Following Nielson's guideline of error prevention (literature review section 2.3) and suggestions for new improvements during interviews (section 3.3.5).

4. **The system shall allow a user to add call frequency and sales quota data by providing an Excel spreadsheet**
   Rationale: This is basic functionality of the system without this data the system would be unable to fulfil its purpose of generating targeting data for the sales force.
   Source: Step 2 of the observation (section 3.5.1).

5. **The system shall validate the data added via Excel spreadsheets**
   Rationale: The global OneLilly application contains a free-text field allowing sales representatives to enter any value for their selected rating but as stated during the observation only certain values are valid and correspond to an objective.
   Source: Following Nielson's guideline of error prevention (literature review section 2.3). This was also raised as an important feature during the interview analysis (section 3.3.4).

6. **The system shall should remove invalid values and inform the user**
   Rationale: The current tool automatically removed invalid entries, as raised in the interview it is essential that this functionality remains in place.
   Source: User's regard the removal of invalid values as a required feature of the system (section 3.3.4). HCI Expert evaluation (section 3.4) highlighted the importance of providing user feedback.

7. **The system shall be capable of allowing a user to specify a mapping between a selected rating and an objective**
   Rationale: Again this is basic functionality of the system without this mapping the system would be unable to fulfil its purpose. Discussions during step 5 of the observation highlighted how the system should follow a user's way of thinking meaning that objectives are added to ratings.
   Source: Step 5 of the observation (section 3.5.1) and the context section of the interviews (section 3.3.4).

8. **The system shall now allow the cross reference to contain duplicate rows**

Rationale: As discussed in the interview the existing system maintains old values and places new below, this causes user confusion and frustration and can be prevented through the use of this requirement.
Source: Following Nielson's guideline of error prevention (literature review section 2.3) and user comments during interviews (section 3.3.4).

9. **The system shall be capable of producing the following data types BSPL, OBJT, OBCF and OBSQ following the OneLilly formal input specification (see Appendix A: Section 2)**
Rationale: This is basic functionality of the system and is required to fulfil its purpose of generating all targeting data.
Source: The context section of the interviews and the observation (sections 3.3.4 and 3.5.1).

10. **The system shall allow a user to view the result for each data type**
Rationale: This is a basic functionality of the system, it is essential for a user to view the resultant data
Source: Interviews and observations (section 3.5.1 steps 7 and 8)

11. **The system shall allow a user to add, edit or delete any entries within each data type**
Rationale: The HTA's (figure 16 and 17) shows that a user is currently able to update any information within the generated data. Users requested that this functionality be maintained since there may be a need to edit data for an individual sales representative.
Source: The final step of each HTA model (figures 16 and 17) and the context section of the interview (section 3.3.4).

12. **The system shall allow the user to save generated data to an Excel spreadsheet**
Rationale: As discussed with stakeholders providing an audit trail is not part of the scope for this project, for this reason it was requested that data can be saved externally to the system. Excel is an appropriate file type since this was already used within the existing system.
Source: Auditing raised during interview comments (section 3.3.4) and compromise discussed within project scope (section 3.9).

13. **The system shall complete verification on any data directly edited**
Details of verification required for each data type is specified within the OneLilly formal input specification (see Appendix: Section 2)
Rationale: This will prevent errors occurring and will result in increased data quality
Source: Following Nielson's guideline of error prevention (literature review section 2.3). Data quality and accuracy was raised throughout the requirements analysis, the observation highlighted this (section 3.5.1).

14. **The system should allow a user to return their task after a break**
Rationale: This will prevent a user either having to stop a task meaning a restart is required next time or rush to complete the task (potentially causing an error to be made). Saving state will increase the efficiency and overall productivity of the task
Source: This was raised during the suggestions for new features during interviews (section 3.3.5).

15. **The system shall be capable of producing the combined 'OBJECTIVES' resultant file following the OneLilly Entity Specification Section 5 – Data File Preparation (See Appendix A: Section 6)**
Rationale: This functionality is essential to completing the task
Source: Step 9 of the observation (3.5.1) discussed user comments to remove this step such that the template is not required but the functionality bought into the system.

16. **The system shall be capable of allowing the user to separate view each data type in the correct OneLilly format**
    Rationale: It is a high priority to ensure that the targeting data is sent to the OneLilly system correctly the first time therefore a user needs the ability to check the end file.
    Source: Following Nielson's guideline of error prevention (literature review section 2.3) allowing such checks will minimise the likelihood of incorrect data being sent.

17. **The system should be capable of producing statistics on the number of records imported and produced**
    Rationale: This task is currently completed manually so incorporating this into the system will again increase the efficiency and overall productivity of the task
    Source: This was raised during the suggestions for new features during interviews (section 3.3.5).

Non-functional requirements

Data requirements

18. **The system shall remove old data once a transaction is complete**
    Rationale: This was discussed through the suggestion of providing auditing functionality; stakeholders agreed that storing previous data was not required.
    Source: Discussed during project scope (section 3.9).

Environmental requirements

19. **The system shall be compatible with the hardware and software available at Eli Lilly offices**
    Rationale: This system is intended for employees of Eli Lilly and therefore it should work on their existing hardware and software
    Source: Interviews section 3.3.4

User requirements

20. **The system shall use language and terminology that is appropriate for users with no previous experience of targeting data**
    Rationale: Some of the OneLilly terminology and abbreviations are not obvious to a user who has had limited experience with targeting tasks
    Source: Interviews section 3.3.4

21. **At a user's request the system should provide context-sensitive help**
    Rationale: The observation of the previous solution saw how a user may require additional help, if this is not provided it may cause them to give up on the task
    Source: This was discussed in the literature review (section 2.3) and the interviews (section 3.3.4) examples of where user assistance was required can be seen throughout the observation.

22. **The system shall allow the user to complete the task in their preferred sequence/order**
    Rationale: The switch between the first solution and the current solution violated the users understanding of the task structure. User's who had varying experience of both solutions found that their understanding was lost when all flexibility was removed in

the current system. The aim of this requirement is to provide flexibility such that any user will be able to easily navigate between different areas of the system.
Source: Observation step 1 (section 3.5.1) discusses user task sequencing preferences. The card sorting session (section 3.6) highlighted the need to maintain flexibility.

23. **The system shall allow the user to view data that they are required to edit or delete**
Rationale: This will give a user a match between the system and the real world, if they see what data is being removed it gives them a better understanding of current system state also
Source: Heuristic evaluation of existing tool (section 3.4)

Usability requirements

24. **The system shall give appropriate, meaningful and timely feedback after a user has completed a task**
Rationale: If a user has not received feedback that a specific task has completed they may be waiting for no reason or attempt to move on potentially causing an error if the previous task is not complete.
Source: Heuristic evaluation of existing tool (section 3.4)

25. **The system shall provide a user with information about the current system state**
Rationale: Keeping the updated on the current system state will prevent them from attempting to complete another task and potentially causing an error.
Source: Heuristic evaluation of existing tool (section 3.4)

26. **The system shall prevent errors where possible**
Rationale: As the observation shows when a user encounters an error it confuses them further and could potentially lead to them giving up on the task. Avoiding errors increases task efficiency.
Source: It was seen that errors occurred throughout the observation. This is also a guideline specified from Nielson (literature review 2.3).

27. **The system shall be easy to navigate and links should be unambiguous**
Rationale: The existing system contains no guidance through the task allowing a user to navigate anywhere, completing any action resulted in an error. The aim of this requirement is to allow the user to understand where they are and the next steps they can pursue.
Source: HCI expert evaluation (section 3.4) highlighted the lack of clearly defined start and end points having a negative effect on the navigational usability. This was also discussed in the literature review (section 2.4).

28. **The system should follow standard design principals as stated in the literature review**
Rationale: To avoid user frustration and improve user experiences
Source: Literature review

This chapter has focused on gathering requirements from stakeholders, including gaining a greater insight into the targeting process, completing interviews, an observation and a task analysis. Discussions of priorities and project scoping have taken place, now the next chapter builds upon these requirements as a foundation to begin design. It is important to note that the requirements may still evolve during the iterative design process.

Chapter 4

Design

The aim of this chapter is to work alongside stakeholders to provide a means to satisfy the requirements stated in the previous chapter and to explore potential navigational design structures.

Preece et al [2] states that there are two types of design: conceptual and physical. The former is concerned with developing a conceptual model that captures what the product will do and how it will be behave whereas the latter is concerned with details of the design such as screen and navigational menu structures, both of these will be considered throughout this chapter.

The design emerges iteratively through design-evaluation-redesign cycles continually involving stakeholders, as discussed in the literature review participatory design will be used throughout this chapter (this was discussed in greater detail in section 2.5). To allow informed user interface design decisions to be made this chapter will include the following participatory design activities:

- Iterative low-fidelity prototyping (section 4.3)
- CARD using Storyboarding (section 4.4)
- Envisioned HTA (section 4.5)
- Iterative higher-fidelity prototyping (section 4.5)

The chapter will then conclude with a summary of the design rationales. Each stage throughout the design will require small meetings of a selected number of stakeholders from OneLilly team at Eli Lilly.

It can be seen that the design is very much an iterative process meaning that implementation will begin as part of the design process to allow higher-fidelity prototyping to take place. As stated in the literature review it is often said that users are unable to know exactly what they want until they are able to see something, iterations therefore occur to allow them to understand what is possible and explore different designs. Therefore it should be noted that the requirements specification is still open to changes.

4.1 Design Rationale

In designing any system decisions are made as the product from a set of possible vague customer requirements to a deliverable entity. Often it can be difficult to recreate the reasons, or rationale behind each design decision. Design rationale is the information about the decisions

made during a design process and the reasons why those decisions were made. Benefits of completing a design rationale include:

- Encourages a range of possible solutions to be explored rather than a narrow exploration of a single solution
- The effort required forces the designer to carefully consider design decisions
- Useful to access at later stages to understand critical decisions and avoid incorrect assumptions being made
- Accumulated knowledge can be reused to transfer what was worked in one situation to another situation with similar needs

MacLean et al [39] proposed the Questions, Options and Criteria (QOC) notation as an approach to design rationale. QOC uses a semi-formal notation which uses questions to identify key design issues each of which is linked to at least two options (providing possible solutions to the question). All options are comparatively assessed, either positively or negatively against a set of design criteria to determine the most favourable option [38]. Figure 18 pictorially shows the QOC notation (an option is favourably assessed in terms of a criterion linked with a solid line, whereas negative links are dashed).

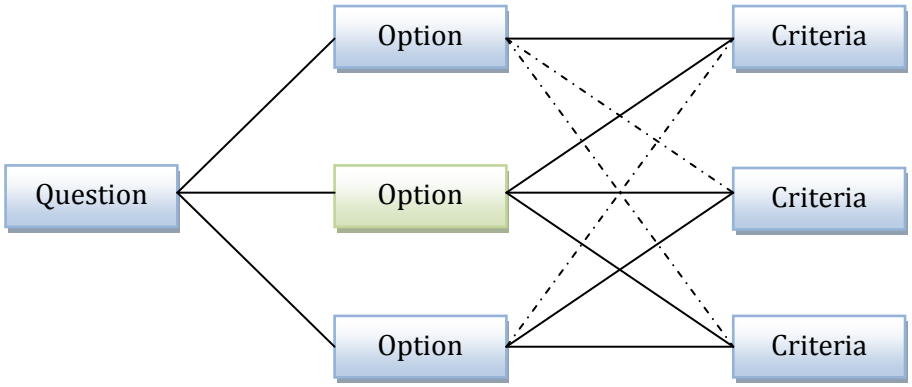


Figure 18. The QOC Notation

The key to an effective design space analysis is deciding the right questions to use to structure the space and the correct criteria to judge the options. The initial questions raised must be sufficiently general that they cover a large enough portion of the possible design space, but specific enough that a range of options can be clearly identified. Questions which isolate single issues are easier to understand and resolve. A bad example might be: 'How should menu's work?' A good question might be: 'How should menus be accessed?', therefore only dealing with one of the issues within the former question [38].

To assist in ensuring that design decisions satisfy every requirements stated in the previous chapter it has been decided that this chapter will use the QOC notation to keep track of design rationales.

4.2 Low-fidelity prototyping

A prototype does not have to be a complex piece of software, it can be as simple as paper-based outline of a screen, an electronic picture or a video simulation of the task. It allows stakeholders to interact with an envisioned product to gain some experience of using it allowing them to easily contribute to the next iterative design.

Having collected information what the users do and not like about the existing solution as well as observing the task being completed within chapter 3 it is now possible to try out ideas by

iteratively building prototypes. This will begin by asking a selection of users were asked to independently sketch their interpretation of what they believe the new system should look like. An example of such a sketch can be found in figure 19, all sketches can be found in appendix B: Section 1.

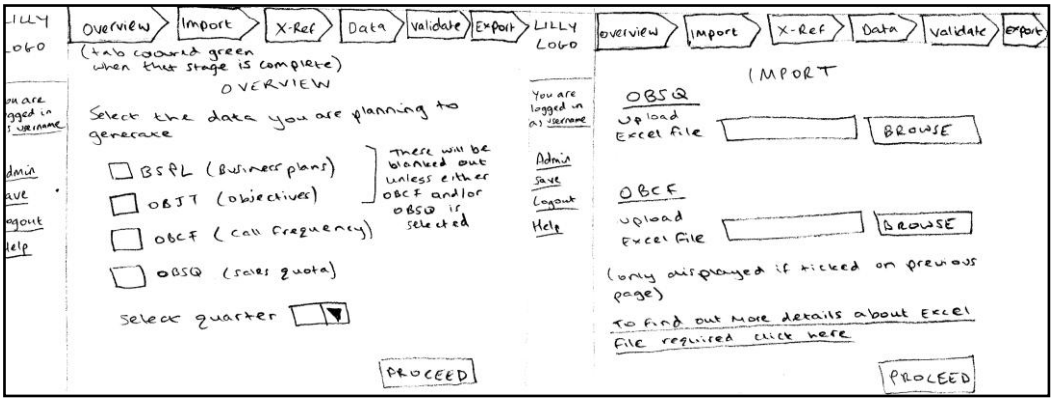


Figure 19. Example user sketch

Once initial sketches were complete all users were brought together and a telephone meeting took place to compare and contrast some of these initial ideas. The interface design dicussions fell into three main areas: Navigational structure, task sequencing and task support. It was decided that these three areas could shape the high-level questions needing to be answered as part of the QOC notation:

Navigation:
Q1: How should the user navigate through the system?

Task Sequencing
Q2: How should the user progress through each sub-task?
Q3: How should the user help be provided?
Q4: How should errors be prevented?

Task Support
Q5: How should data be added to the system?
Q6: How should mappings be made between ratings and objectives?
Q7: How should data be generated?
Q8: How should this data be validated?
Q9: How should the resultant file be exported?

Through analysis and discussions of these sketches it is now possible to have an initial attempt at answering these questions, a summary of this and the conclusions made will now be given.

4.2.1 Navigational structure

Obviously with this being the most significant aspect of this project it was a keen discussion area after the initial sketches. Throughout this discussion it was noted that the criteria needing to be satisfied are requirements:

22: Flexibility
27: Easy to navigate

Interestingly all three users designed slightly different navigational structures, figure 20 shows one of which was particularly intriguing since it did not follow any standards.

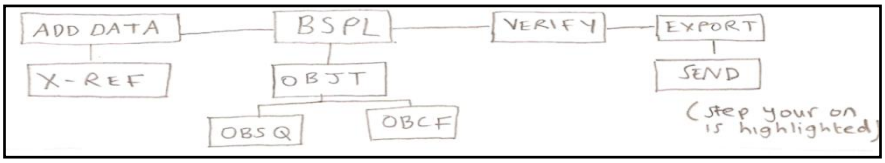


Figure 20. Navigational structure designed by an inexperienced user

Further discussions with the user saw that she had drawn how the task "maps out" in her head. It is possible to see how this compares to the comments raised during step 1 of the observation (section 3.5.1), where the verification of data is set out in a hierarchical structure with a "top-down" approach. This design structure was discussed amongst the group and it was decided that this would not be appropriate. Firstly this is because the design considers how one single user views and understands the process but as the requirements chapter highlighted users have differing preferences on the flexible tasks. Secondly the other two users commented on how this was not a standard navigational structure and so may not be clear that the items are clickable, it also takes up additional space on the screen and may lead to confusion for some users. The designer agreed with these comments but also stated how she would like to keep the idea of highlighting the page or step the user currently at.

Figure 21 and 22 show the remaining two user sketches, both of which adopted a "breadcrumbs" style, this compares to comments raised during the interviews (section 3.4.5).

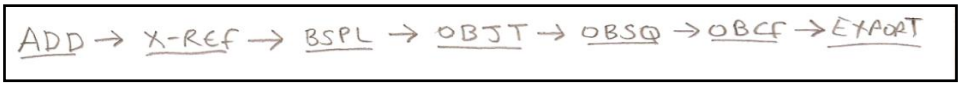


Figure 21. Navigational structure designed by a user with minimal experience

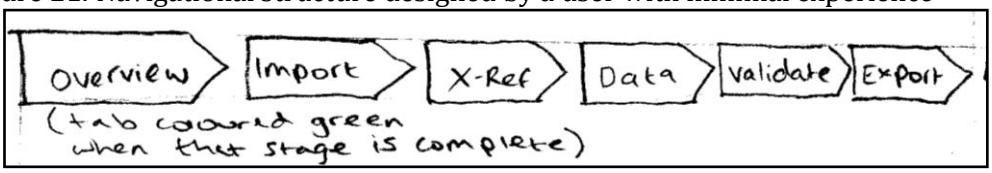


Figure 22. Navigational structure designed by an experienced user

The design concept of breadcrumb items representing each sub-task remains the same in both of these sketches. As indicated in the literature review this will guide and indicate the users current location within the system. One of the noticeable differences between each of these designs is the content of the breadcrumb items; figure 4.4 has listed all the data types (which are obviously that particular user's preference) whereas figure 4.5 has moved all verification tasks within one breadcrumb item "Data" and then allowed the user to navigate to each data type from within this page. Again it is important to remember that different users have a difference preference of the order in which they verify each data type meaning the breadcrumb labels in figure 4.4 would not be appropriate for all.

Other comments were raised during this discussion, firstly one designer added a validate section and the other did not. The designer of figure 21 discussed how she wanted each sub-task to be assigned to a label. It is possible to see that this is an experienced user since she is transferring her knowledge of the existing system where data is viewed and validated separately. The designer of figure 21 commented how she presumed the system would complete basic verification on behalf of the user and any edits being required from the user can be done whilst viewing each data type. This discussion concluded with an agreement that user validation would be completed by the system and user verification can be completed whilst viewing each data type this meant that this section could be removed. There was also a comment raised about the need for an "overview" section (a sketch of this section can be seen on the left hand side of figure 19), after all users reviewed the design for this page it was agreed that the system should allow the user to specify which data types the system will generate. This is additional requirement which will need to be added to the requirements specification.

Finally it is useful to note that all users designed the links to the sub-tasks on the top of the page and auxiliary functions were contained within a left hand side menu. User's were asked whether they considered having sub-tasks contained within the side menu but all agreed that having it on the top of the screen made more sense since it is a guidance through the task whereas a side menu may be thought as simply options.

In summary the options discovered here were:
O1: "Mind-map"
O2: Breadcrumbs
O3: Side Menu

The current decision is to progress with breadcrumbs but with the comments and conclusions from each of these three designs being brought together to produce another design of the navigation structure and will form part of the next prototype iteration.

4.2.2 Task Sequencing

This obviously ties in with the navigational structuring since this will be the main guidance through the task but the aim of this section is to answer the question of how a user should use this structure to successfully complete the task. Again Throughout this discussion it was noted that the criteria needing to be satisfied, these are the following requirements:

18: Treating each 'transaction' separately
21: Help at the current location
22: Flexibility
26: Error prevention
27: Easy to navigate

A good starting discussion is figure 23 where it can be seen that one of the users designed a "proceed" button.

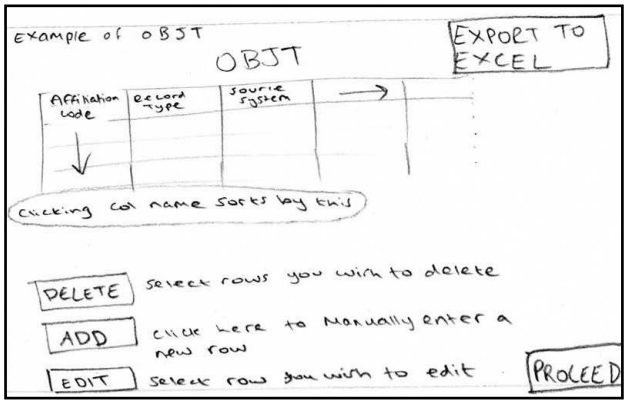


Figure 23. User Sketch showing proceed button

This button would obviously move the user onto the next sub-task making it very clear what a user's next actions or task should be. Other users stated that they assumed they would be required to use the navigation structure to manually click onto the next sub-task (as the hyperlinks show in figure 22). Reviewing the criteria it was decided that a combination of both of these approaches would be suitable since it will be easy to navigate and provide flexibility such that a user is easily able to navigate to any sub-task from any single page. The remaining criteria were yet to be considered in these low-fidelity prototypes; instead these were discussed and comments will be built into the next prototype iteration.

The task sequencing will affect how each transaction is treated separately since an end point needs to be reached and the user needs to be aware that once this is reached all data will be

removed. Users discussed how this could be achieved and decided it would be useful to make it clear within the navigational structure that there is an end point. This could be achieved with the following two options:

O1: A "finish" breadcrumb item
O2: A "finish" button on the final screen

Once the transaction is complete all data needs to be removed this can be added to a finish button. Having an additional breadcrumb item would bring no extra benefit since there is nothing to be placed in this section therefore the second option is the most appropriate.

Additionally users discussed need to be able to terminate the task without necessarily completing it (e.g. last minute business decision to postpone objective creation or if there was an error with imported data). This can be completed using a button or option that when clicked will terminate the transaction and remove all data. Users stated that a prompt would be useful to remind them that data will be removed and to ensure that they wish to terminate without sending or saving any data.

As discussed during the interviews (section 3.3.4) many of the common errors were caused due to insufficient guidance through the task meaning users had the freedom to navigate to any sub-task and potentially incorrectly run a query. Although not every error is related to the navigational structure, it is a good idea to review the errors made during the observation (section 3.5.1) to understand how they could be prevented. These errors along with potential solutions are summarised in table 2.

Common Error	**Possible Design solutions**
Incorrect pre-editing of business objects report	1. Prevent pre-editing being required by importing based on column name rather than location
Incorrect options chosen during import (these were access specific)	1. Minimise the number of options required 2. Pre-set all options enabling the user to simply add a file only
Duplicate rows present in the cross reference table	1. Prevent duplicate rows being added 2. Prevent saving (or proceeding) whilst duplicate rows are present in the table
Attempting to view data without first specifying a mapping between each selected rating	1. Disabling the 'proceed' button from the cross reference page 2. Allow the user to move to the correct page but with no data present
Running queries in an incorrect order	1. Do not give users direct access to queries
Specifying an incorrect quarter	1. Allow user to select quarter 2. Automatically set quarter (based on current date)

Table 2 Common errors and possible design solutions

Finally although the design of the help is not contained within these initial prototypes, it was considered that this could either be in written form or using videos. As previously discussed during the interviews users preference is video format.

In summary the options discovered here were:

Q2
O1: Manually click through menu items
O2: Proceed button redirecting to the next most logical sub-task
O3: A combination of both of the above

Q3
O1: Written instructions
O2: Video

The options for question four were specified in table 4.1. As with the previous section the conclusions drawn from this section will now be taken forward to the next prototype iteration.

4.2.3 Task Support

As described throughout this project it is absolutely vital that the system design effectively supports all tasks. For this reason the questions to be asked are split into each of the sub-tasks required to enable a user to reach their end goal of delivering the generated data in the correct OneLilly format. Again Throughout this discussion it was noted that the criteria needing to be satisfied, these are the following requirements:

4, 7, 9, 10, 11, 15: Specifying core functionality
1, 2, 3, 5, 6, 8, 13, 18: Supporting data integrity

Due to time constraints only one user (experienced) completed screen designs for every section, the other two users completed 2-4 screen designs. Due to this some of the design options were discussed from just one or two sketches.

ADDING DATA

As shown in figure 24 all user sketches followed a consistent design using an "upload box" to add data into the system.

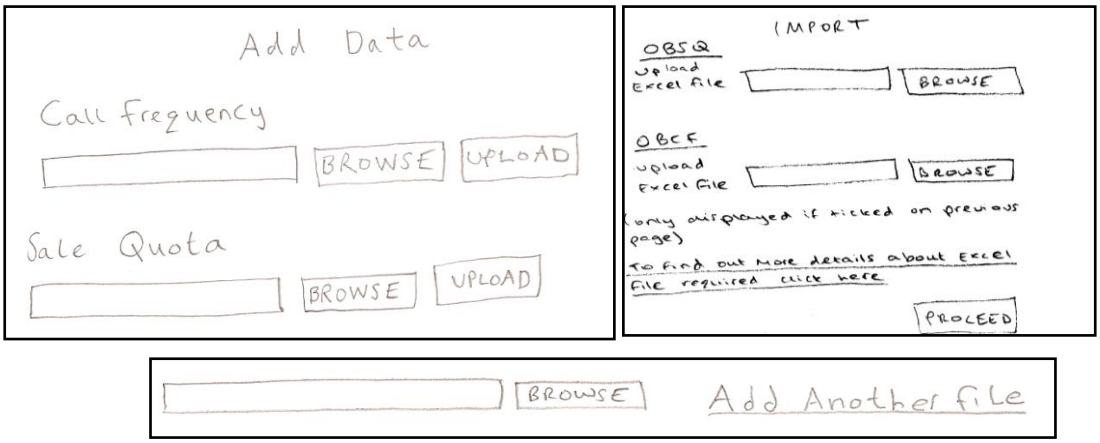


Figure 24. User sketches for upload functionality

There are a couple of things to note here; firstly two of the designs do not contain an "upload" button and secondly the varying designs of how the upload boxes are displayed.

One user commented that she simply did not think about the details of data being added to the database and the other user stated that her design would add the data contained within the Excel sheet to the database once the "proceed" button was clicked. In order to satisfy requirements 5 and 6 (validation of data contained within the spreadsheet) it would be more appropriate to add the data whilst still within the "import" section so that the feedback is returned to the relevant section.

Currently there are three designs options for the display of upload boxes:

O1: Always display both upload boxes (Call Frequency and Sales quota)
O2: Only display the upload box if the data type was selected on the "overview" page
O3: Display one upload box and allow the user to add another if required.

The final option can be dismissed for two reasons: firstly it is unclear which data type needs to be uploaded first and secondly this would require unnecessary additional clicks to be made. With reference to Nielson's 5th heuristic 'Error prevention' it has been decided that the second

option is the most appropriate since it minimises user confusion by displaying an upload box just for the data required.

SPECIFYING A MAPPING

Two of the three users sketched a design for the cross reference table; these can be seen in figure 25 and 26.

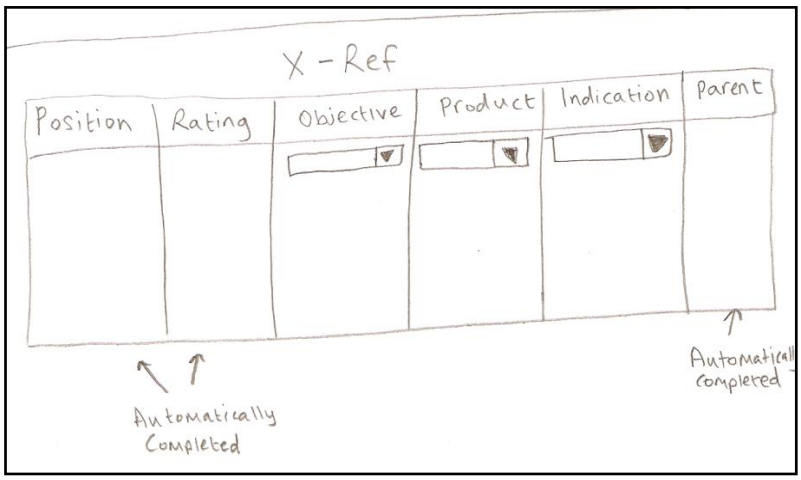


Figure 25. Cross reference Design 1

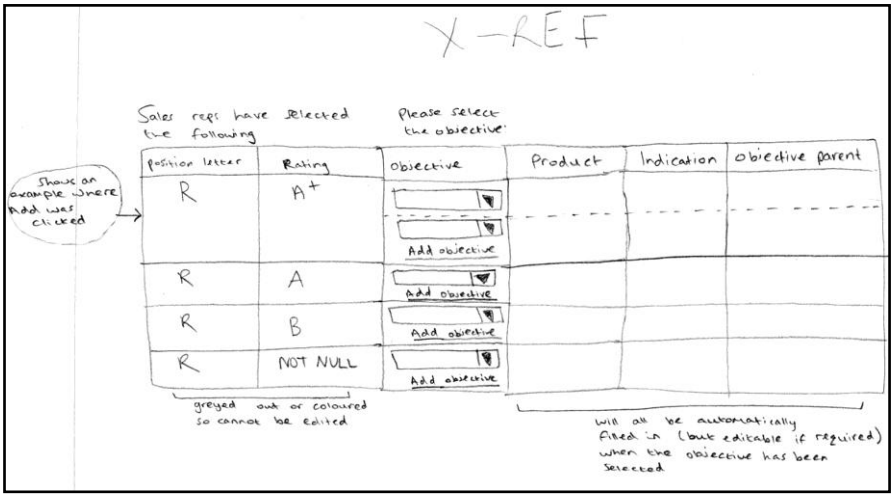


Figure 26. Cross Reference Design 2

Obviously figure 25 contains more detail but some similarities are shown between the designs, this includes the general layout of the table (would have been taken from the existing solution), the inclusion of drop-down boxes and notes about some fields being completed automatically.

Looking back at the observation step 3 (section 3.5.1) it was noted that it is possible for the final three columns (product, indication and objective parent) to be derived from the objective field and this is reflected in user's sketch shown in figure 26. Both designs use a drop-down list allowing the user to select the objective. Two of the users agreed that both of these should be implemented since this would fix those issues described in the interview and observation of incorrect values being entered. The third user discussed the potential difficulties of having "set" objectives the possibility of only an administrator to edit the contents of the drop-down box. This is obviously a company process decision whereby the current roles and responsibilities are being questioned and this decision will affect the system design. This therefore leads to the following options for the objective field of the cross reference design:

O1: Drop-down box to select objective: contents only editable by an administrator
O2: Drop-down box to select objectives: contents editable by any user
O3: Free-text entry

The final option was immediately dismissed since this will cause the same errors currently being experienced with the existing system. Therefore whichever decision it has been decided that a drop-down box will be used.

GENERATING DATA

The existing solution required users to manually run separate queries to generate each data type, as already discussed the new system will prevent users from having direct access to such queries therefore this needs to be considered for the UI design. None of the user sketches made any reference to how this could be done; further discussions showed users had differing opinions which again will reflect different options as follows:

O1: Queries will be hidden from the user such that they will be automatically ran when the "proceed" button (within the cross reference section) is clicked.
O2: As above but rather than the "proceed" button individual queries will run as each data type is clicked to be viewed.
O3: On the 'Data section' include buttons which when clicked will run the relevant query.

The final two options are not appropriate since as previously discussed in the observation queries have to be ran in a particular order (e.g. call frequency data has to exist before their objectives are generated) so the first option is the only one where errors can be prevented.

DATA VALIDATION

Two of the three users sketched designs for how data would be viewed and validated by the users. Both used a standard table design displaying all columns as seen in figure 27.

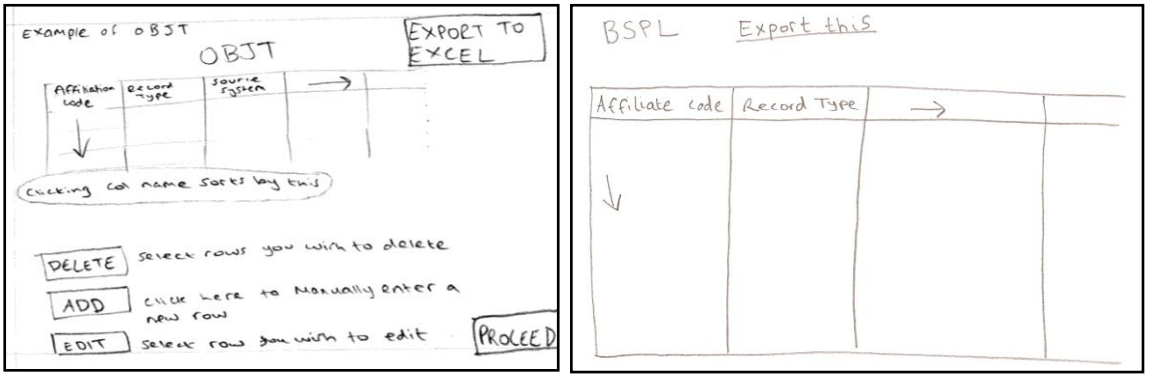


Figure 27. Designs

The only difference between these two designs is the presence of the 'add', 'edit' and 'delete' controls. When this was raised during the discussion the designer of figure 27 (right hand side) stated that although it was missed off her sketch there is a need for the ability to 'edit' or 'delete' a particular entry. Secondly she stated that she does not believe that there is a need for an 'add' button since all entries are based on data added and therefore if data is missing it should be generated from the beginning of the process. Users agreed with the comment raised and decided that there is only a need for 'Delete' and 'Edit', this new decision will impact requirement number 11 since the 'add' functionality needs to be removed.

In terms of how the data itself should be validated there are two options:

O1: Only allow valid data to be added to the system (therefore removing invalid during import)
O2: Allowing the user to specify which entries are invalid at the cross reference phase (as the existing system does)

The second options provides additional flexibility such that if there was a special case selected ratings (or the standard ones were to be edited) then it would still be possible to use the system.

When this was discussed with the users it was clear that such a circumstance would be very rare and if the standard selected ratings were to be edited then this would be a one-off case only meaning the system itself should be updated. The first option makes the task simpler for a user and follows Nielson's heuristic to prevent errors were possible.

EXPORTING AND SENDING RESULTANT DATA

Again two of the users sketched designs for the export functionality, as figure 28 shows there is a slight variation in the users preferred options.

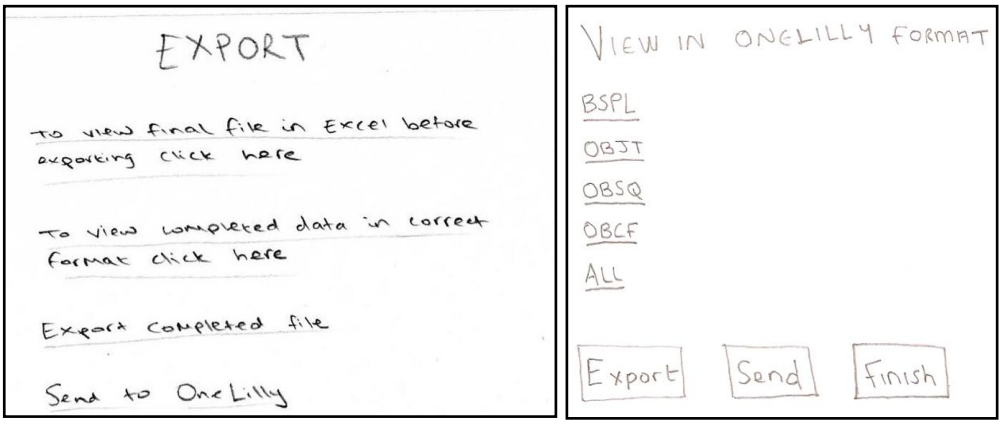


Figure 28. Export designs

Comparing the two designs there are two differences: firstly the second design allows the user to separately view each of the data types in the correct format and secondly the first design contains an option to view the final file within Excel. From further discussions it was seen that the ability to view each data type separately will not being any additional benefit than viewing the complete file. The ability to export the completed file to export turned in a debate since one user (the main user of the existing system) stated that this functionality is required to allow further checking to take place (i.e. it is possible to sort/filter within Excel) whereas the other users stated that they would not use this functionality since they have already had the ability to export and check data in previous sections.

In terms of the question of how data should be exported there are two options:

O1: When 'Export' is clicked the completed is placed on shared server AND automatically sent to OneLilly (since the user has the ability to view what will be sent before export is clicked)
O2: Keep functionality separately such that it is saved to server when 'Export' is clicked and sent to OneLilly when 'Send' is clicked.

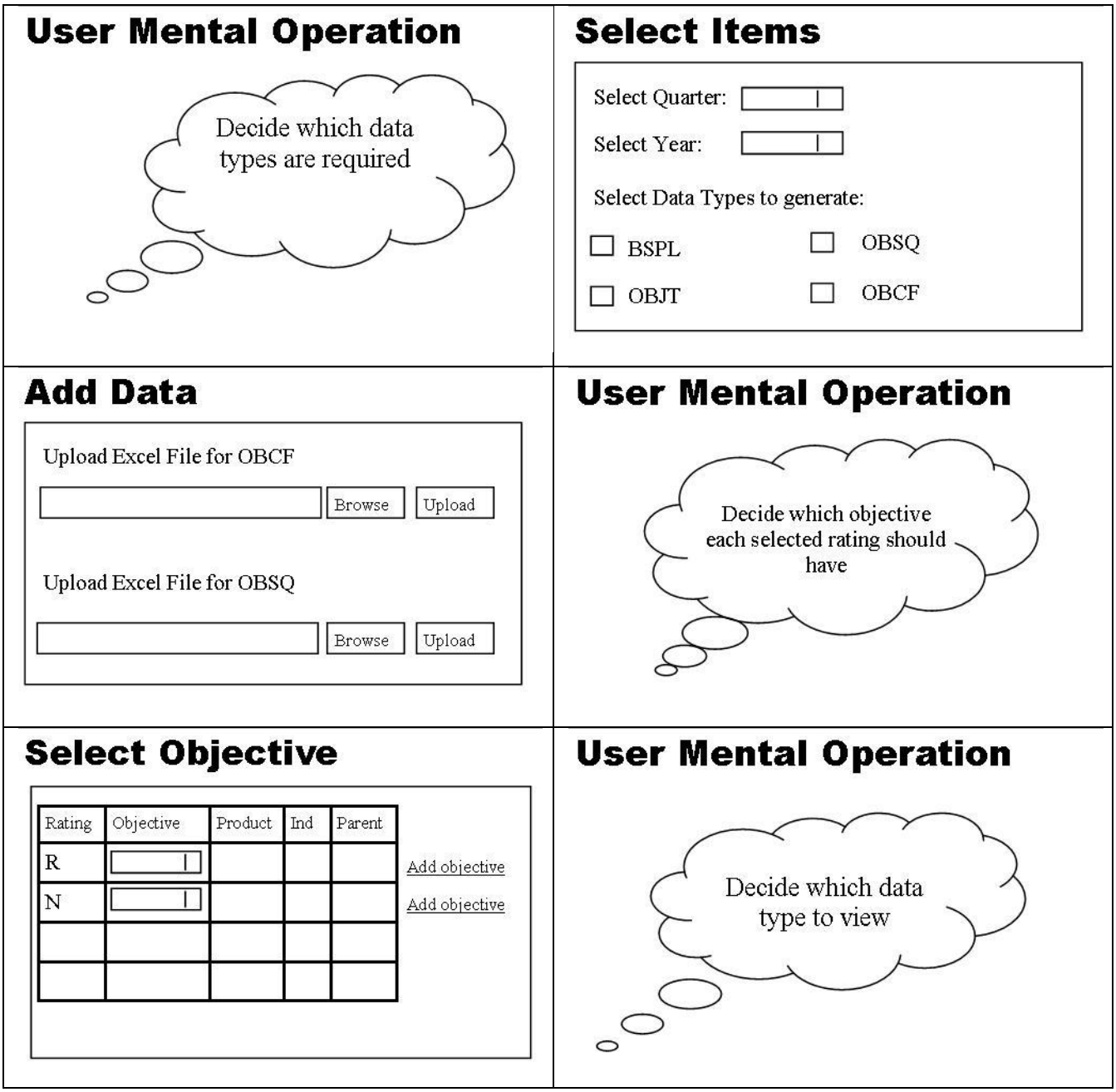
The first option will reduce the number of clicks that are required without loosing any functionality but the second option is following the same process as the existing system. After a small debate users chose the second option simply because this is what they are used to.

A first iteration of design decisions is now complete and as stated throughout this section the next step is to work through another iteration which will combine all comments and conclusions that were made here. This iteration will use storyboarding the reason for this is to allow users to attempt to interact with the prototype to allow them to see how they might progress through an example task. It will encourage users to explore new ideas, suggest modifications or notice something that may be missing or incorrect within the current designs.

4.3 CARD using storyboarding

As described in the literature review (section 2.5.3) CARD (Collaborative Analysis of Requirements and Design) is a participatory design technique used to explore workflow options. This will offer users a chance to role-play with the prototype and attempt to interact with it by stepping through a particular task**.** Although earlier the decision was made to use breadcrumbs as the navigational structure the ordering of breadcrumb items is yet to be set. Understanding the workflow particular users follow is important to complete the design decision of how breadcrumb items should be ordered. It is essential to make sure that they are in an appropriate order to successfully support the user.

Figure 29 shows the cards that were designed for this session (Note that cards can represent screens, user's goals or their intentions).



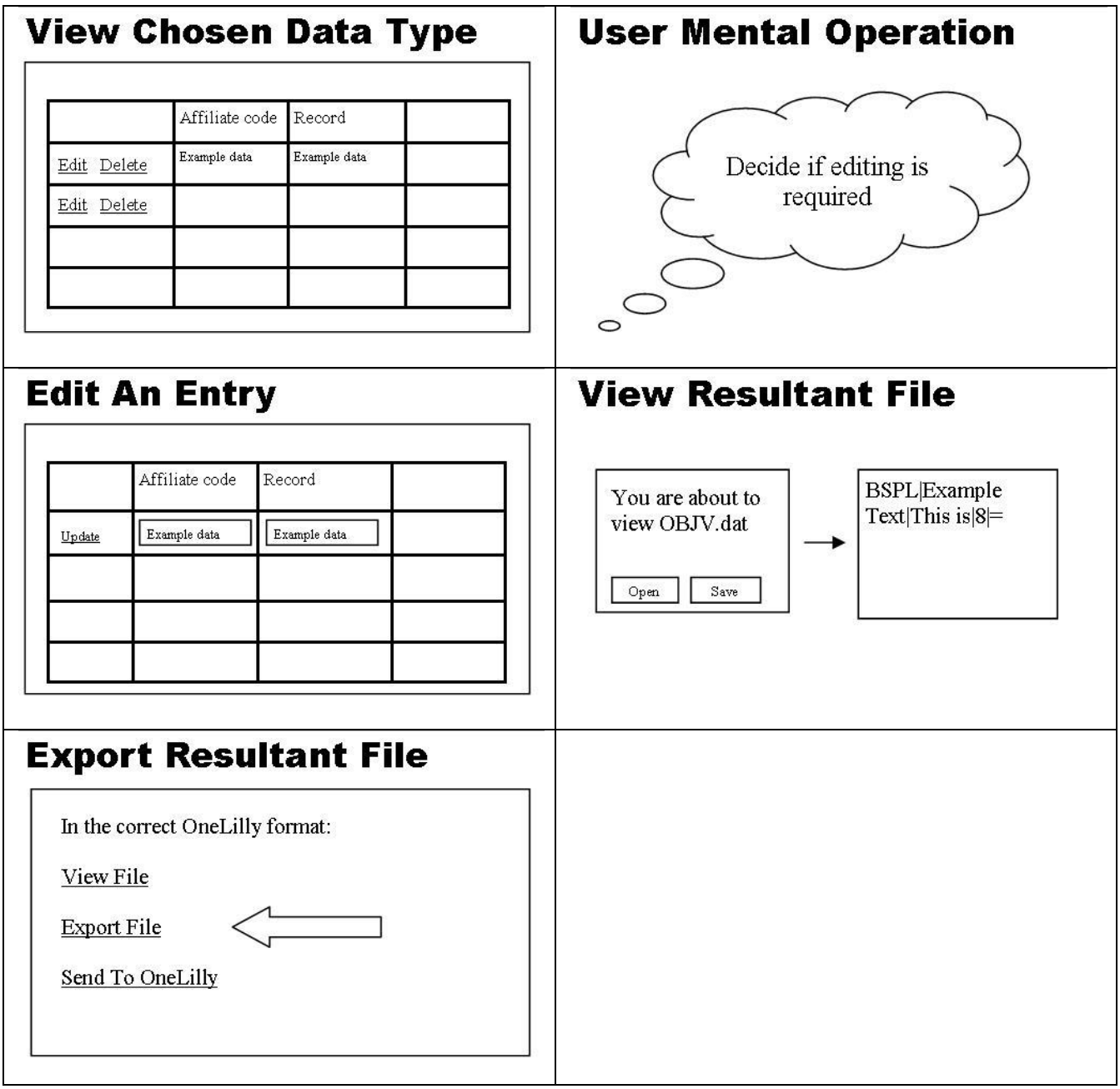


Figure 29. Cards used for CARD session

Note: Although it is not shown on this insert cards were numbered 1-11 working left to right.

Two users participated in this activity but due to travel requirements this CARD session had to be conducted electronically. Each user was sent a copy of the cards along with a small subset of example data for one sales representative. The following text shows the instructions that were sent to each user:

```
Imagine the cards are now the system and you need to generate OBCF and the
corresponding data only for the 192R sales representative.
Simply arrange the cards in the order you would expect/like to see screen
whilst you complete the targeting data.
   - you may use a card more than once (which you will need to since there
     is only one card for viewing data but you will have more than one)
   - You can also create your own cards if you feel there is something
     missing

Please either write on the cards (or paper if you prefer) any decisions you
made at a particular step e.g. you selected 'OBCF' and 'OBJT' or you
```

```
decided that editing was 'not required'. I understand that you have limited
time but if you could also consider anything that you feel is missing or
not right and take any notes on this. Maybe you have a new idea? Or thought
of something that is missing?
```

(A full copy of the email sent detailing all instructions the users were given can be found in Appendix B: Section 2).

4.3.1 Results

A copy of the results (returned via email) can be found in Appendix B: Section 2. As seen within this reply the completion of this activity has resulted in the findings of a new requirement, one of the users found that the design of the cross reference currently does not include a column to specify the call frequency. Comparing these results with the discussions around breadcrumb items in section 4.3 (navigational structure) it can be seen that this activity has confirmed breadcrumb items need to be in the following order:

Overview* -> Add data -> Cross reference -> Review data -> Export

*Specify data types required

The results also show that an additional card was required to view feedback from the import (this is from a decision made in the previous section). As this activity has discovered the design of this feedback is yet to be considered, consequently further questions needs to be considered.

Earlier the question "how data should be validated?" (Q7) was answered by choosing the option to only allow valid data to be added, as a result of this design decision further questions needs to be considered:

Q7a: How should feedback be returned to the user?
Q7b: What feedback is required?

The options for these questions were considered via a telephone call [40] with two of the users. These can be summarised as follows:

O1: Displaying the results in a table below the import box
O2: Displaying a message box
O3: Simply display the invalid data so that the user is aware of exactly what was not loaded
O4: Above plus row number
O5: Above plus reason for rejection

From the observation it was seen that users tend to ignore message boxes so the second option is more appropriate to ensure users take note of the feedback. For part b all users would prefer to have the final option but the first option is required at a minimum.

Obviously the designer also needs to be aware of the requirements that a data set needs to satisfy in order for it to be valid, for the sales quota these are set out within the OneLilly formal input specification (see Appendix A: Section 2). For the selected ratings the experienced user provided an email (see Appendix B: Section 3) listing the requirements.

It can be seen from the results that the only difference in workflow was at card number 6 where each user chose a different data type to verify first. This shows that requirement number 22 (providing flexibility) has been satisfied with this prototype.

This CARD session has provided an understanding of the high-level actions required to complete the task, it is now a good idea to consider each of these actions in greater details. This

can be done using a hierarchal task analysis as previously seen in chapter 3 this involves breaking tasks down into sub-task and then into sub-subtasks and so on.

4.4 Envisioned HTA

An envisioned HTA will be generated based on findings from the previously conduced HTA (section 3.7) and the design decisions that have been made so far. Upon completion it will be discussed with stakeholders to make sure they have a good understanding of how the system will support each sub-task allow them to suggest any restructuring.
Figure 30 shows the envisioned HTA.

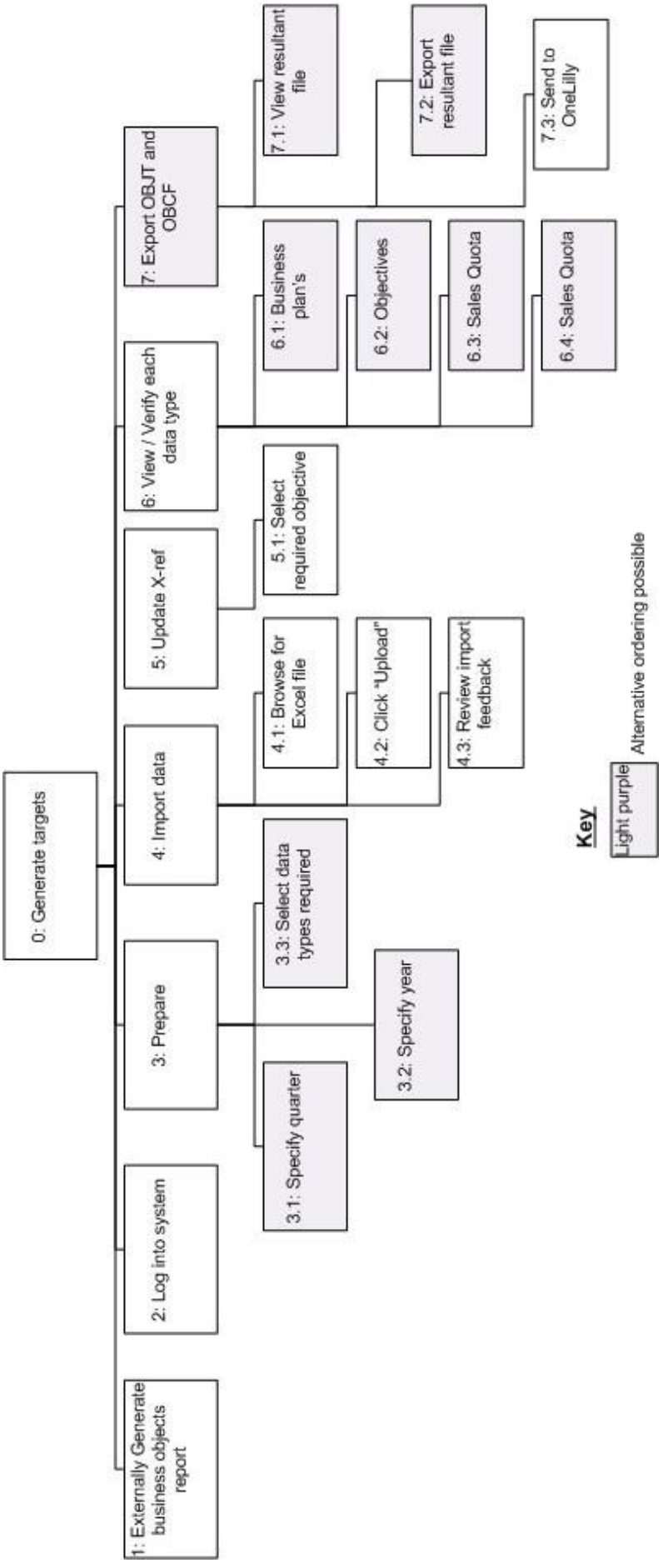


Figure 30. Envisions HTA

Comparing this HTA to those completed in chapter 3 the first thing to notice is the significant reduction in the number of steps required (it is now possible to represent all sub-task within the diagram) and secondly it is possible to see the increased amount of flexibility. A copy of this HTA was emailed to a selection of users to comment on but only positive feedback was returned since all users agreed with the task breakdown.

So far stakeholders have been heavily involved to complete two and in some cases three iterations though low-fidelity prototyping. Every design question has had at least two options provided and a decision made based on learning's from previous chapters and user expressed preferences. The next part of the design process is to begin implementing higher-fidelity prototypes. Such prototypes are more like the final system and will allow the design decisions made so far throughout this chapter to be tested.

4.5 High-fidelity prototyping

The purpose of this project is to develop a fully functional prototype so that it can be successfully handed over to the company to complete longer-term testing following their business processes. Therefore it has been decided to iteratively develop the prototype using the .NET framework rather than common high-fidelity prototyping tools such as Visual Basic or Macromedia. At this stage, both design and implementation are being carried out simultaneously.

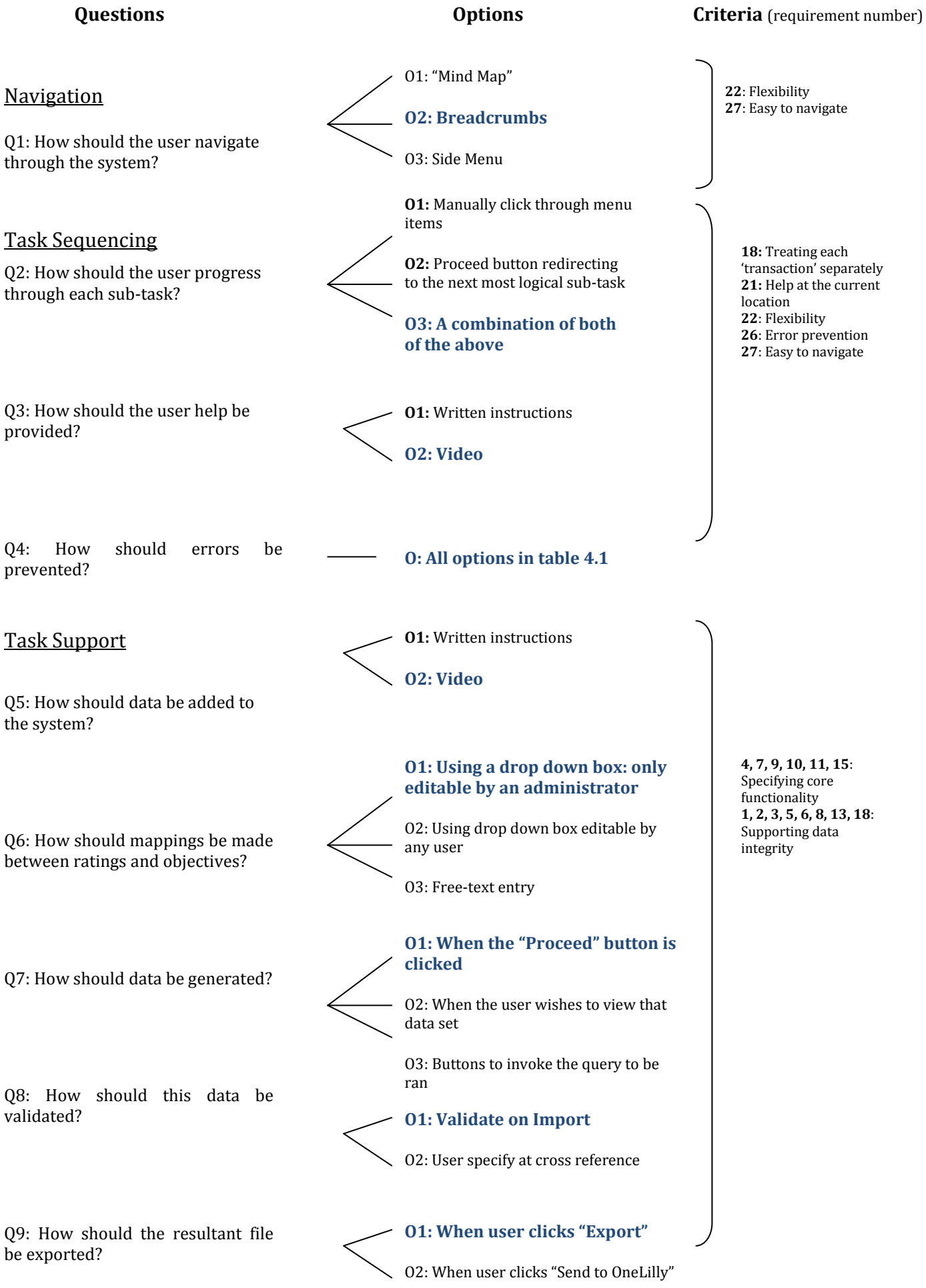
The process will again entail iterative development continuously gathering user feedback. This section of the design document will only note any further design decisions that arise from this process, the remaining details of iterative development can be found in the next chapter where implementation details are discussed in greater detail.

There was only one significant finding during user experimentation of a high fidelity prototype, this was a potential issue was found with the cross reference table. Currently if a user saves the cross reference and moves onto view data but finds a mistake they are unable to re-update the cross reference table successfully. This is because the design had only considered this to be updated once only. Further discussions with the user it saw that an additional requirement was needed to specify that the system should allow multiple updates of the cross reference table. This will prevent the need to for the task to be restarted and so increases productivity.

Although there were no other findings that impacted the requirements specification, throughout the implementation phase there were many more user comments which continued to feed into the design. These included comments such as colour schemes, number of rows visible, placement of buttons and so on.

4.6 Conclusion

All design questions have now been answered with sufficient evidence that the appropriate decision was made. Now follows a summary of the QOC notation used throughout this chapter.


Questions
Options
Criteria (requirement number)
Navigation
Q1: How should the user navigate through the system?
O1: "Mind Map"
O2: Breadcrumbs
O3: Side Menu
22: Flexibility
27: Easy to navigate
Task Sequencing
Q2: How should the user progress through each sub-task?
O1: Manually click through menu items
O2: Proceed button redirecting to the next most logical sub-task
O3: A combination of both of the above
Q3: How should the user help be provided?
O1: Written instructions
O2: Video
18: Treating each 'transaction' separately
21: Help at the current location
22: Flexibility
26: Error prevention
27: Easy to navigate
Q4: How should errors be prevented?
O: All options in table 4.1
Task Support
Q5: How should data be added to the system?
O1: Written instructions
O2: Video
Q6: How should mappings be made between ratings and objectives?
O1: Using a drop down box: only editable by an administrator
O2: Using drop down box editable by any user
O3: Free-text entry
Q7: How should data be generated?
O1: When the "Proceed" button is clicked
O2: When the user wishes to view that data set
O3: Buttons to invoke the query to be ran
Q8: How should this data be validated?
O1: Validate on Import
O2: User specify at cross reference
Q9: How should the resultant file be exported?
O1: When user clicks "Export"
O2: When user clicks "Send to OneLilly"
4, 7, 9, 10, 11, 15: Specifying core functionality
1, 2, 3, 5, 6, 8, 13, 18: Supporting data integrity

As stated in the introduction and found throughout this chapter the previously stated requirements specification is open to changes. Here follows a list of those additional or modified requirements:

Modification to requirements:

11. **The system shall allow a user to edit or delete any entries within each data type**
    Rationale: The HTA's (figure 3.12 and 3.13) shows that a user is currently able to update any information within the generated data; users requested that this functionality be maintained since there may be a need to edit data for an individual sales representative.
    Source: The final step of each HTA model (figures 16 and 17) and the context section of the interview (section 3.3.4).

Additional functional requirements:

29. **The system shall allow a user to specify which data types they wish to be generated**
    Rationale: This provides the user with flexibility making the task easier to complete
    Source: User designs (section 4.3) sketched functionality this was then agreed by a selection of the target population

30. **The system shall be capable of allowing a user to specify a call frequency for each selected rating**
    Rationale: The call frequency is decided by business partners based on the selected rating therefore this cannot be pre-set meaning the user is required to input this value
    Source: A user discovered this was missing when working through a scenario during the CARD session (section 4.4)

31. **The system shall allow a user to terminate the 'transaction' at any time**
    Rationale: If there are import errors then the user may wish to restart, alternatively the user may wish to restart or terminate if new or different data set has been provided by business partners.
    Source: User designs (section 4.3) within the task sequencing section

Additional user requirements:

32. **The system shall allow a user to return and edit the cross reference during a single transaction**
    Rationale: Required to support the scenario of a user making a mistake or a business decision changing (e.g. a call frequency of 2 is selected instead of 3). This requirement will prevent the need for the task to be restarted and so increases productivity.
    Source: Nielson's 9th heuristic of allowing users to easily recover from errors. This was highlighted during user experimentations with higher-fidelity prototypes (section 4.6) it was seen that there is sometimes a need to make changes to the cross references.

This chapter has seen how participatory design techniques have successfully been used to appropriately and accurately answer design questions. All user feedback has directed further

iterations and this will now continue throughout the implementation stage. The next chapter will now describe the development environment in which the new OneLilly targeting application is being developed in and give details of the technical background.

Chapter 5

Implementation and Testing

The aim of this chapter is to describe the implementation details of how the findings from previous chapters were used to develop the new OneLilly targeting application. It will begin by giving an introduction to the .NET framework and discussing why ASP.NET was chosen as the development environment. It will then move onto an exploration of a recently added extension to the framework: language-integrated query (LINQ) which proves to be particularly useful for this implementation.

The chapter will also describe the database set-up, class structures and provide detailed descriptions of how the main features were implemented.

As discussed numerous times, development is an iterative process so participatory design techniques will continue to be used allowing the interface to be constantly evaluated. The feedback obtained will continually be fed back into the design and new iterations. A brief discussion of the feedback obtained and subsequent changes made in the interface will be discussed and finally the chapter will conclude by detailing the testing that took place throughout.

5.1 An Introduction to the .NET Framework

The .NET framework created by Microsoft is a general purpose software development platform that allows different programming languages and libraries to work together seamlessly to create windows-based applications. The framework consists of two main components: the .NET framework class library and the common language run time (CLR).

The class library consists of an object-orientated collection of reusable classes that can be used to develop a variety of applications. The CLR is the foundation of the framework which manages code at execution time, figure 31 shows the visual overview of this.

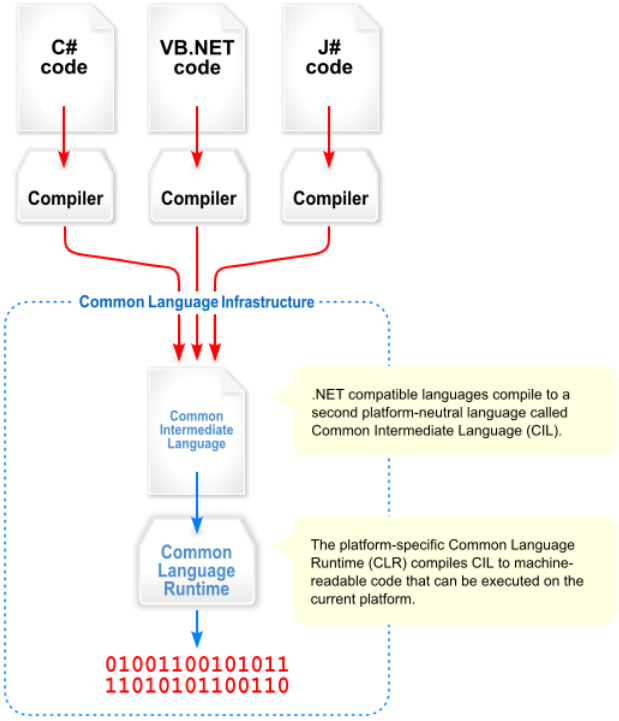

C# code
VB.NET code
J# code
Compiler
Compiler
Compiler
Common Language Infrastructure
Common Intermediate Language
.NET compatible languages compile to a second platform-neutral language called Common Intermediate Language (CIL).
Common Language Runtime
The platform-specific Common Language Runtime (CLR) compiles CIL to machine-readable code that can be executed on the current platform.
01001100101011
11010101100110

Figure 31. Overview of the .NET Common Language Runtime

It can be seen that high-level language compilers for C#, VB.NET and C++ are provided to turn source code into common intermediate language (CIL), the CLR then compiles this into machine readable code that can be executed.

5.1.1 ASP.NET

ASP.NET is used to build web based applications. It is part of the .NET framework and is built on the common language runtime allowing programmers to write ASP.NET using any language which can be compiled to Common Intermediate Language.

Using the .NET framework drastically reduces the amount of code required to build applications because of the amount of functionality available ``for free'' in the framework, such as user and role management. In addition to this, the availability of rapid application development tools (Visual Studio) with visual designers for initial layout supports iterative prototyping. It has therefore been decided that this is appropriate for the development required.

Some of the additional advantages of using the .NET framework and in particular ASP.NET include:

- ASP.NET makes development simpler and easier to maintain with an event-driven, server-side programming model
- The source code is compiled the first time the page is requested. Execution is fast as the Web Server compiles the page the first time it is requested. The server saves the compiled version of the page for use next time the page is requested
- Easy access to ODBC data sources for working with Excel files
- Easy integration with existing technology in use at Eli Lilly

ASP.NET also contains powerful database functionality in order to facilitate interfacing with a database, and has particularly strong links with SQL Server. The recently added LINQ to SQL (Language Integrated Query) extensions to the framework simplifies data access further.

This project will use SQL Server to create a relational database and LINQ to SQL for accessing this data.

5.1.2 LINQ to SQL

Language-Integrating query (LINQ) gives programmers the ability to query and transform data using any .NET language. LINQ can be used with any data source for example from XML documents, relational database tables or inside a collection of objects.

LINQ to SQL is the .NET Language-Integrated Query for relational data. It allows the programmer to model a relational database using .NET classes. It is then possible to query the database using LINQ, as well as update/insert/delete data from it. Section 5.3 provides more information on how this is set up.

5.2 Database Structure

The relational database structure was designed based on the learning's from previous chapters and it was found that the system needs to include tables for: imported data, cross reference information, final output and storing user information. Therefore following tables are required:

- A table for each of the data types that can be included in the generated objectives file
  - **BSPL**
  - **OBJT**
  - **OBSQ**
  - **OBCF**
- A table for the selected ratings data to be imported into: **SelectedRatings**
- A table to store selected rating mapping to objective: **CrossReference**
- A table to store the mapping between an objective and its related fields (product, indication and parent objective): **ObjectiveMappings**
- Tables to store user information
  - User details: **Users**
  - Role details: **Roles**
  - Mapping between a user and their role: **UserInRole**

Note there is no table for the sales quota data to be imported into this is because there is no intermediary format. Data is loaded straight into the OBSQ table. The data types to be included in the generated objectives file need to follow the OneLilly input specification which can be found in Appendix A: Section 2. The SelectedRatings table was designed based on the information provided in Appendix B: Section 3 and the remaining tables were designed based on the findings from the observation in chapter 3 (see section 3.5.1). Figure 32 shows the database diagram.

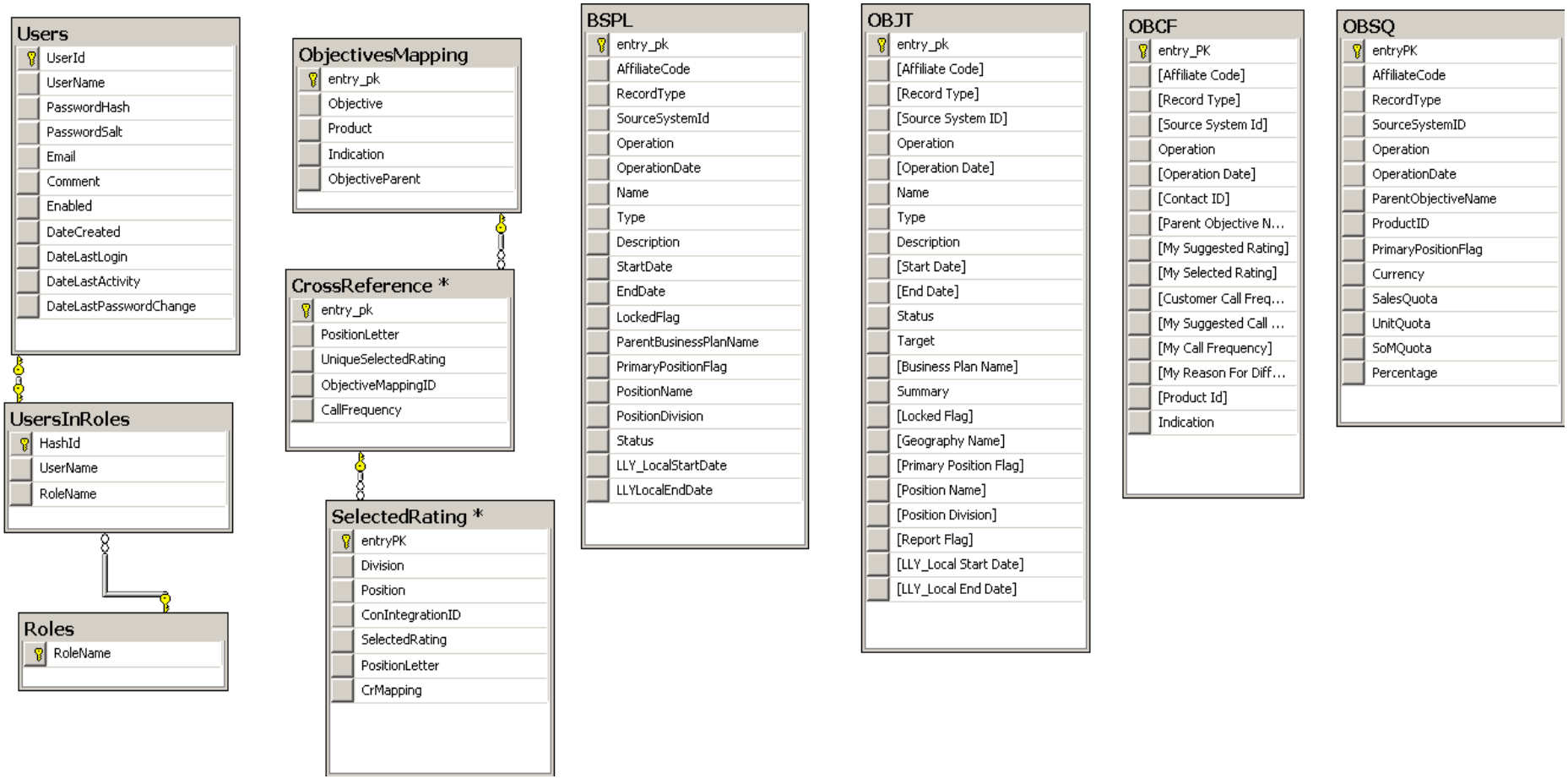


Figure 32. Database Diagram

For the purpose of this project there was no need to set up the relationships between the four data types. The OBCF table is updated based on data contained within the SelectedRatings table and then following this the OBJT and BSPL tables are updated based on the data contained within the OBCF table.

5.3 System Architecture

Using the technologies just discussed figure 33 shows a high level overview of how the implementation is structured.

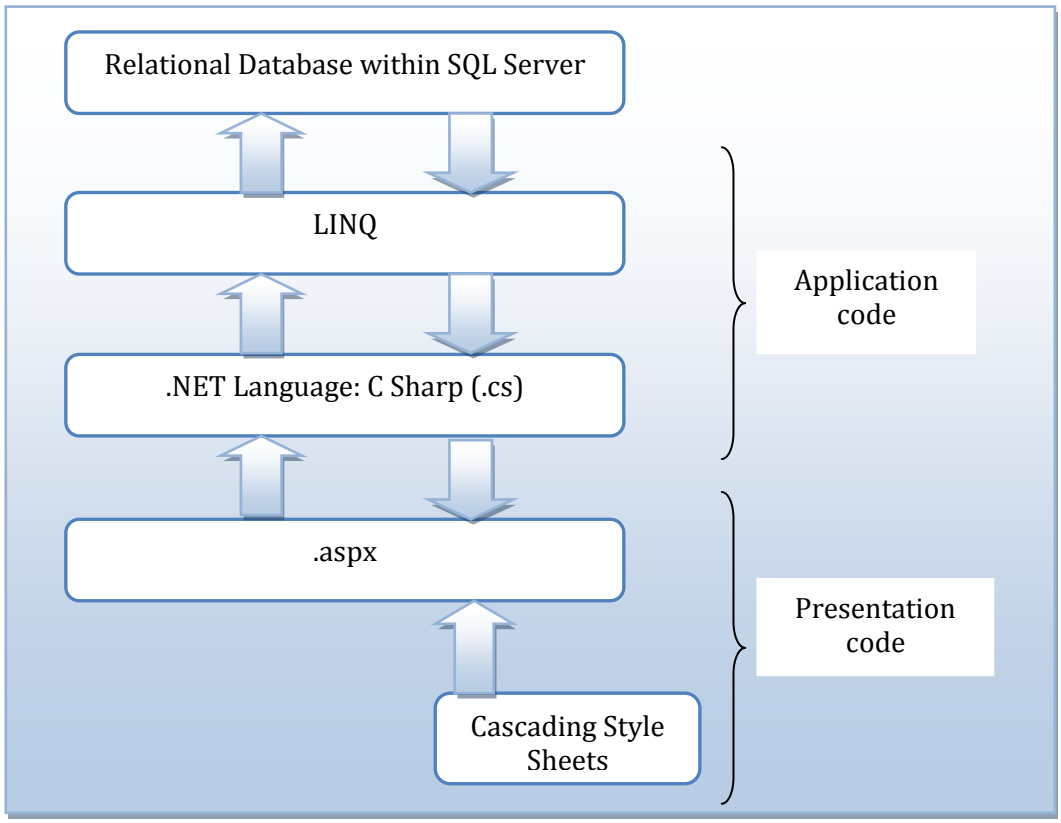


Figure 33. Overview of System Implementation

As figure 33 shows ASP.NET uses code-behind class files (.cs files), this allows the presentation code to be separated from the core application code. The code-behind class file is compiled so that it can be created and used as an object. This allows access to its properties, its methods and event handlers.

This separating of layers is following the Model-View-Controller (MVC) architecture. The model represents the information (the data) within the relational database, the view corresponds to the elements of the user interface which is contained within the presentation code (.aspx and CSS). Finally the controller manages the detail and communication which is contained within C Sharp classes. C Sharp is an object-orientated programming language again developed by Microsoft. It was chosen because it offers the power of C++ and the simplicity of Visual Basic making it easy to write and maintain code.

The benefits of following the MVC architecture in this way include:

- It is possible to provide alternative user interfaces for the same model (particularly useful when dealing with individual or specific user interface requirements).
- Will make maintenance and code re-use easier (user interface changes will be much easier)
- The clear separation makes the testing of the application much easier

One of the drawbacks of using such a model is the rigorous separation between the model and the view can means that there are more files to manage and could potentially lead to increased complexity making debugging more difficult.

This Model-View-Controller framework was originally proposed in the 1980s and is one of the most widely used for GUI design [44]. More recently there have been further research projects that have come up with alternatives for example Joelle Coutaz developed the PAC model.

It is now possible to begin implementation following this architecture and using the conclusions made during chapter 4.

5.4 System Development

The main 'sections' (overview, import, cross-reference, each data type and export) required have already been thoroughly discussed in chapter 4, each of these will now form pages with a code-behind class file. Additional classes will be required for importing and exporting.

Figure 33 shows the high-level class structure for each of these including the LINQ objects required. Note light blue shades reflect .aspx pages with a code-behind file (.cs) and green shades reflect classes (.cs) only. Following this a description of the most significant sections of code are described.

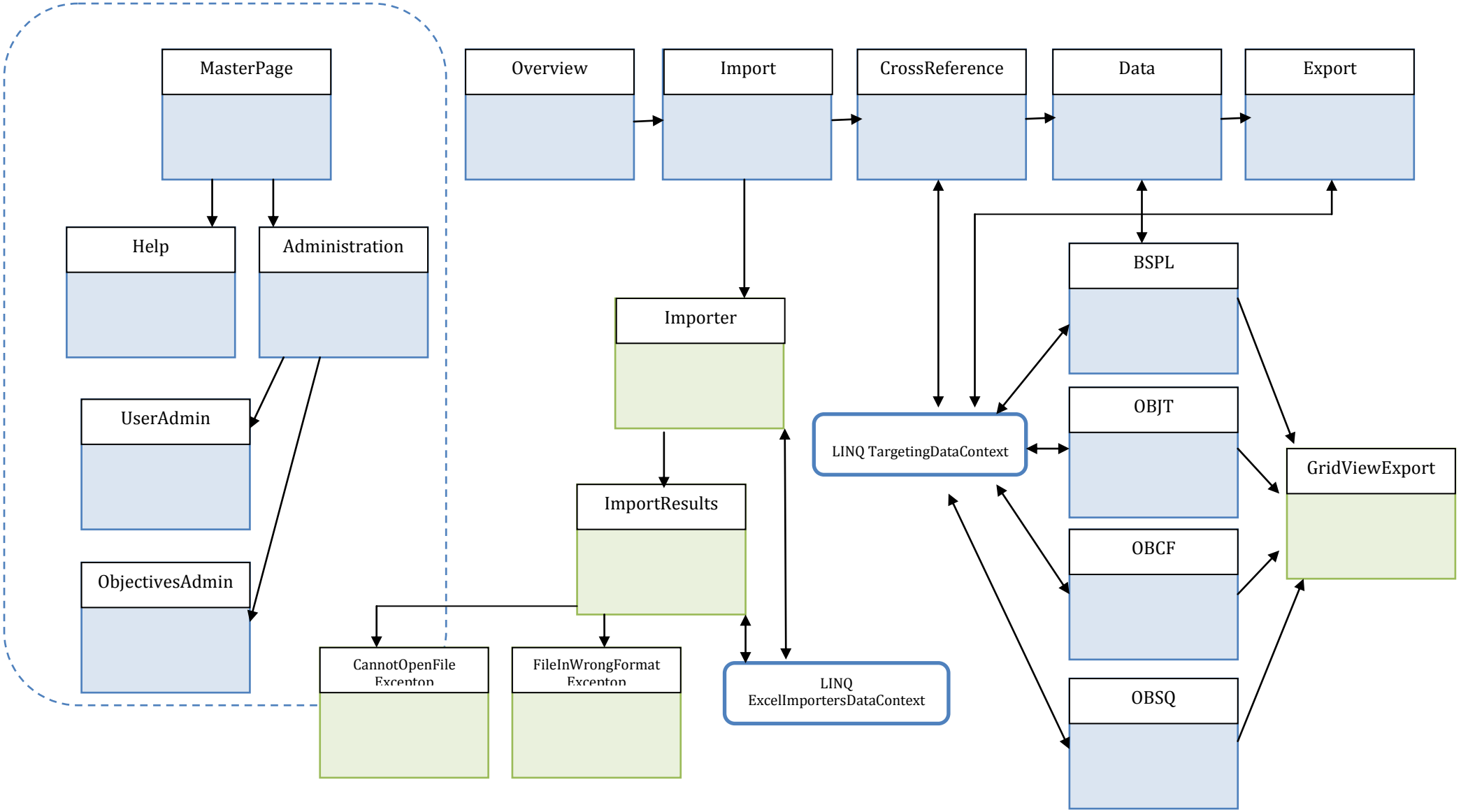


Figure 34. High-Level Class Structure

5.4.1 Navigational Structure: Master Page

To provide consistent layout throughout the application a master page has been used. This is where the site navigation structures are contained. Following earlier designs (See Appendix B: Section 1) this page will contain three content panes:

1. Left Bar: This is the left menu and will contain the Lilly logo at the top and buttons for logging out and accessing admin and help
2. A breadcrumbs placeholder: This will be placed at the top of the page and implements the breadcrumb items as described in section 4.3.1 allowing a user to navigate to any sub-task.
3. Content placeholder: This is where the custom content for each individual page will be added

As shown in figure 34 this master page also requires a code-behind file this is where the functions for each button click are contained.

5.4.2 Importing Data

This page is again built based on design decisions made in section 4.2.3 this is shown in figure 35)

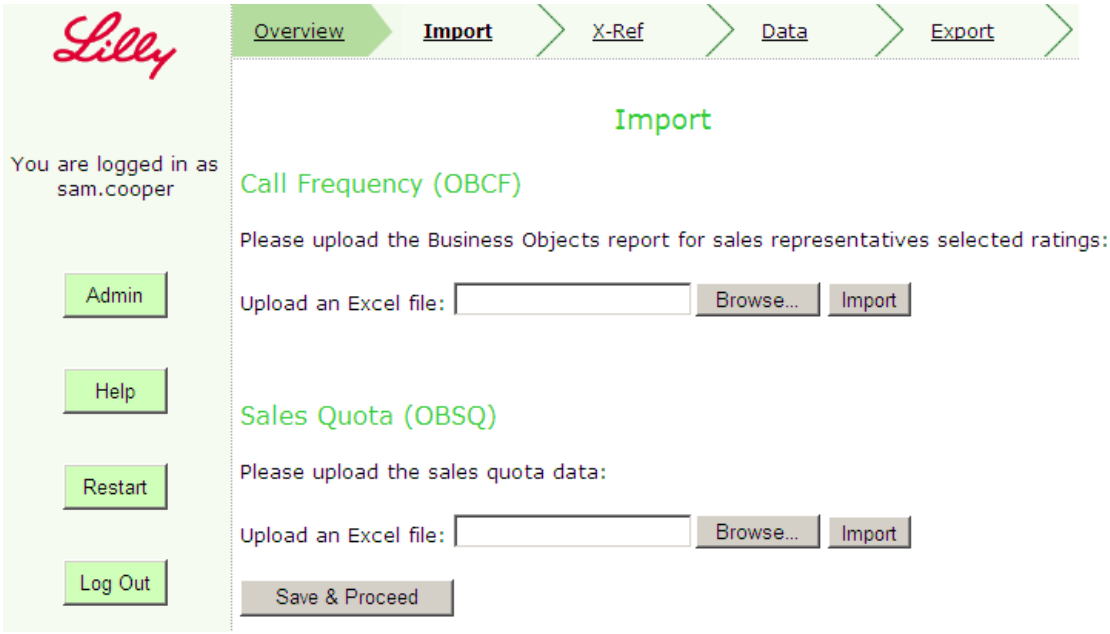


Figure 35. Print screen of the import screen

Error Prevention: Upload Control box visibility

As decided in section 4.2.3 the upload control will only be visible if the user selected the tick box to generate this data on the overview page. This has been implemented using session variables,

when the user clicks 'Save & Proceed' from the overview page each of the required variables are saved to a session variable. An example:

```
Session["OBSQ_required"] = BSPL.Checked;
```

Session variables can be accessed from any other ASP page and they can be remembered from one page to another. Here is an example of the code used to assess the variable from another page:

```
Boolean OBSQ_required = (Boolean)Session["OBSQ_required"];
```

So for this particular page the control box is only visible if the `OBSQ_required` variable was set to true.

Uploading data from Excel to Relational Database

Inserting data from a local Excel file into the SelectedRatings table of the OneLilly database was done using ADO.NET (ActiveX Data Objects). ADO is a library contained within the .NET framework and is used to access data and data services.

The Excel file was opened through the OLE DB (Object Linking and Embedding Database) provider of ADO.NET, this is an API again designed by Microsoft for accessing different types of data stored in a uniform manner.

The first step is to establish a connection string:

```
string excelConnectionString =
String.Format("Provider=Microsoft.Jet.OLEDB.4.0;Data Source={0};Extended
Properties=\"Excel 8.0;HDR=YES;\"", fileName);
```

This is requesting to open an Excel 8.0 file (location to file is stored in variable `filename` which is passed into the method) using OLEDB. The HDR=YES in extended properties states that the first row is to be used as column headings these can then be used in select statements.

The next step is to open the connection and read data (using a SELECT statement to choose the required columns) from the Excel sheet:

```
using (DbCommand command = connection.CreateCommand())
                {
                    // Main$ comes from the name of the worksheet
                    command.CommandText = "SELECT [Division], [Position],
[Con Integration ID], [My Selected Rating] FROM [Main$]";

                    try
                    {
                        connection.Open();
                    } catch (Exception)
                    {
                        //This is if the file cannot be opened
                        throw new CannotOpenExcelFileException();
                    }
```

Using such a SELECT statement means it does not matter which order the columns appear within the spreadsheet, although there will still be an issue if the column header names are changed.

The code then continues onto read each row of data and as concluded within section 4.3.1 this data needs to be validated therefore each row is checked against a set of constraints (these are discussed in Appendix B: Section 3). For this reason two lists are required one which will store those records to be imported and the other to store records with errors:

```
List<EISelectedRating> okToImport = new List<EISelectedRating>();
List<KeyValuePair<int, EISelectedRating>> problems = new
        List<KeyValuePair<int, EISelectedRating>>();
```

EISelectedRating is the object which models the SelectedRating table within the database. The list of problems uses a KeyValuePair to enable it to store the row number of where the validation failed providing the user with more information.

The list containing records that passed validation checks these now need to be added to the SelectedRating table via LINQ. As discussed in section 5.1.2 LINQ allows the database to be modeled using a class (this class is named ExcelImportersDataContext) and data is added using the following code:

ExcelImportersDataContext db = new ExcelImportersDataContext();

```
foreach (EISelectedRating r in okToImport)
{
    db.EISelectedRatings.InsertOnSubmit(r);
}

db.SubmitChanges();
results.NumberOfRatingsSuccessfullyImported = okToImport.Count;

return results;
```

EISelectedRating is the name of the table that data will be loaded into and okToImport is the list containing valid records to be inserted.

The code is firstly creating an instance of the database model and then looping through each item in okToImport and adding its values to the table. Changes are then committed to the database and the number of records successfully added returned to be displayed on the user interface.

The list containing records that did not pass the validation is looped through and added to a table displayed to the user. Figure 36 shows an example result:

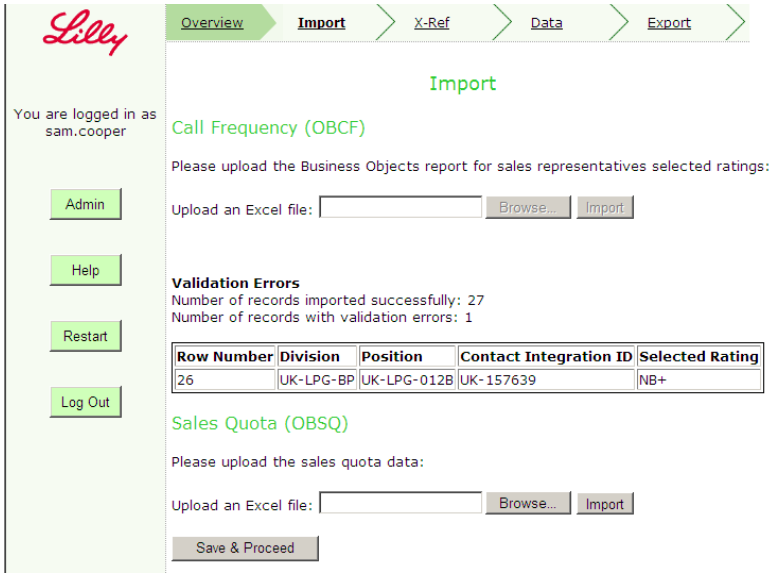


Figure 36. Print screen of the import screen after file upload

As can be seen from figure 36 there is an option to restart (within the left menu) if the user wishes to make appropriate changes to the spreadsheet and import again. As discussed in section 5.4.1 this menu is contained within the master page meaning the code for restart is not part of the import page. If restart is clicked it simply removes all data from every table within EISelectedRating ready to start a "fresh transaction".

Finally clicking the 'Save & Proceed' button here simply redirects the user to the cross-reference page.

5.4.3 Cross Reference

This cross reference table needs to be generated based on the data just added. It needs to contain unique values of the SelectedRating and position letter fields from the EISelectedRating table and automatically place these into the cross reference table (these values are non-editable to the user). Additionally there are two columns which will need to be updated (using a drop-down box) by the user: Objectives (with a related Product, Indication and Parent Objective) and a Call Frequency. An example generated table is shown in figure 37.

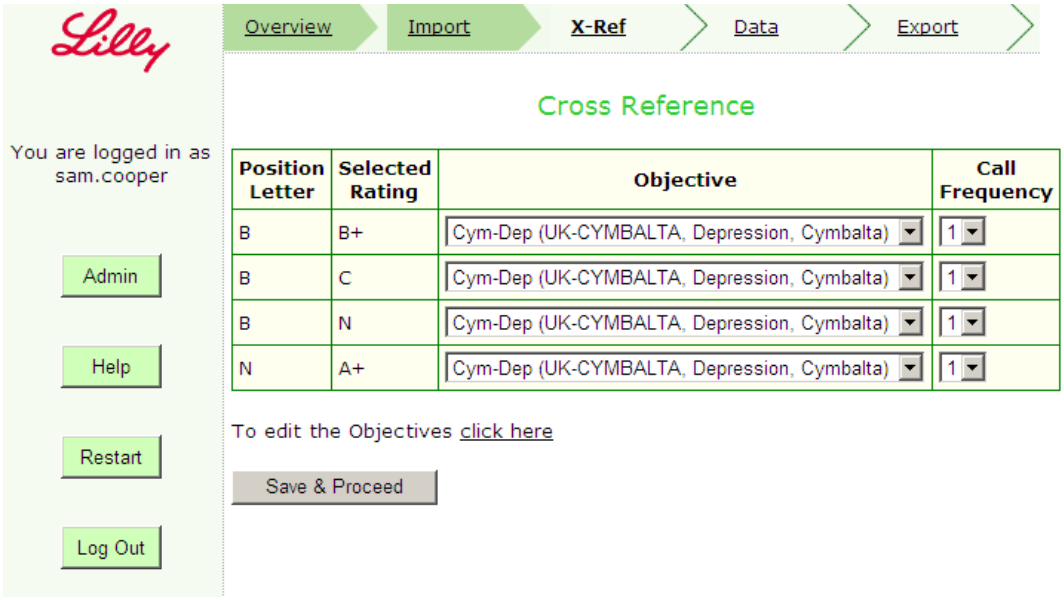


Figure 37. Print Screen of an example cross reference table

This table needs to be generated when the page loads. The first step is to access the database to get the data required. The following code shows this:

```
TargetingDataContext db = new TargetingDataContext();

//unique position & letter - items needed in x-ref
var ratingList = (from sr in db.SelectedRatings
                  orderby sr.PositionLetter
                  select new
                  {
                      sr.PositionLetter,
                      sr.SelectedRatingCode
                  }).Distinct();

var dropDownItems = (from obm in db.ObjectivesMappings
                     orderby obm.Objective
                     select obm);
```

As with the previous description again an instance of the database model is created, note that this is a different model to the one used by Excel Importers (since it contains different tables). The code shows the two queries required, the first queries from the data imported to return the distinct values of PositionLetter and SelectedRatingCode. The second queries from the ObjectivesMapping table (this table remains the same between "transactions" but can be updated by an administrator) to return all objectives.

The next step is to bind the results from the first query to controls, this is done using .DatBind() as shown here:

```
rptUpdate.DataSource = ratingList;
rptUpdate.DataBind();

foreach (RepeaterItem i in rptUpdate.Items){
```

Each row of the cross-reference table is then dynamically updated with the unique position letter and selected rating.

The results from the second query are used to update the objectives drop-down box and this is done by simply adding each item to the DropDownList:

```
DropDownList list = (DropDownList)i.FindControl("cmbObjectiveMapping");

//add items to the objectives drop-down list
foreach (ObjectivesMapping m in dropDownItems)
{
                ListItem l = new ListItem(String.Format("{0} ({1}, {2},
{3})", m.Objective.Trim(), m.Product.Trim(), m.Indication.Trim(),
m.ObjectiveParent.Trim()), m.entry_pk.ToString().Trim());

list.Items.Add(l);
}
```

The last column in the table contains the drop-down list for the call frequency, this is done in the same way as above, firstly by creating the list item (items needed are the numbers 1-4) and then adding each item to the drop down control.

At this stage it is important to note that the additional requirement found during high-fidelity prototyping (section 4.5) has been met, this was to allow the user to return and update the cross-reference table during the same transaction. This was met by adding in an extra step which checks whether a mapping has already been saved and if so updates each variable:

```
CrossReference current = null;
try
{
        current = db.CrossReferences.SingleOrDefault(p => p.PositionLetter
== posLetter && p.UniqueSelectedRating == selRating);
}
catch (Exception)
{
        current = null;
}
```

If there is not already a mapping specified then the 'current' variable is set to null. This is then used when updating the objectives drop-down list by checking whether current is not null and if so selects the already chosen value. The other factor to note is that when the table is saved for a second time previous data will need to be removed before new is added, this is done as follows:

```
bool crossReferenceAlreadyHasData = (db.CrossReferences.Count() > 0);
if (crossReferenceAlreadyHasData)
{
        db.CrossReferences.DeleteAllOnSubmit<CrossReference>(db.CrossRefere
nces);
}
```

When the user clicks save the first step will be to save the selected mappings (or if required delete and then save) to the CrossReferences table and then finally use this table containing the selected mappings to update the relevant tables. The session variables described earlier are

again used but this time to determine whether a particular query is required to be run (depending on whether the user selected that particular data type at the overview screen). The code listings for each of these queries can be found in Appendix E.

Lastly the user is redirected to the data screen, this is where all generated data can be viewed and edited. Figure 38 shows example print screens of the prototypes:

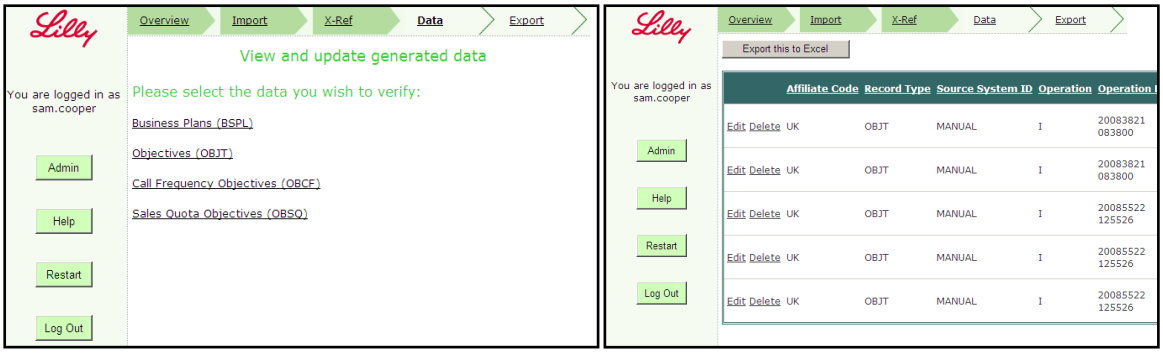


Figure 38. Print screen of viewing and editing data

As requested in the design as shown in figure 38 it is possible to export the results to an Excel file, the next section gives a brief discussion of the implementation details.

5.4.4 Export

The export control works by using the StringWriter class to write each row of data into a table to form an output stream. This is then put into a HttpContext object (this encapsulates all information related to the request allowing the programmer to access it outside of the actual page) and then writes this out:

```
HttpContext.Current.Response.Write(sw.ToString());

HttpContext.Current.Response.End();
```

Where ‘sw’ is the StringWriter which contains the output stream of data contained within the GridView. (The actual GridView that is exported is not the one that is displayed; instead there is a separate hidden one. This is needed to prevent the ‘Edit’ and ‘Delete’ labels being added).

When the document is being served from the server, it needs to prompt the user to save the file directly to the user's disk, without opening it in the browser.

```
HttpContext.Current.Response.AddHeader("content-disposition",
string.Format("attachment; filename={0}", fileName));
```

However, for known MIME (Multipurpose Internet Mail Extensions) types such as Microsoft Excel ("application/ms-excel"), but is possible to use the content-disposition header to override this default behaviour:

```
HttpContext.Current.Response.Clear();

HttpContext.Current.Response.ContentType = "application/ms-excel";
```

The same concept is used when exporting the end file but the ContentType is set to “text/plain” rather than Excel.

Appendix E contains the full listings of each of the main classes, to see the full set of code please refer to the attached CD. A description of how participatory design was used throughout this iterative implementation will now be given.

5.5 Participatory Design at the Implementation Phase

Due to time and location constraints it was not possible to complete participatory design directly with users, instead email and telephone communications had to be made throughout the implementation phase.

During the development the application was locally hosted to enable users to freely access and test it throughout (next section describes this in greater detail). This provided continual user feedback which successfully guided iterative development ensuring that the system worked as expected. Feedback obtained in a very of ways including telephone calls whilst the user was using the system, email feedback (an example can be seen in Appendix C: Section 1) and annotated print screens. Figure 39 shows an example of one of the ways in which users provided feedback (further sketches can be seen in Appendix C: Section 2).

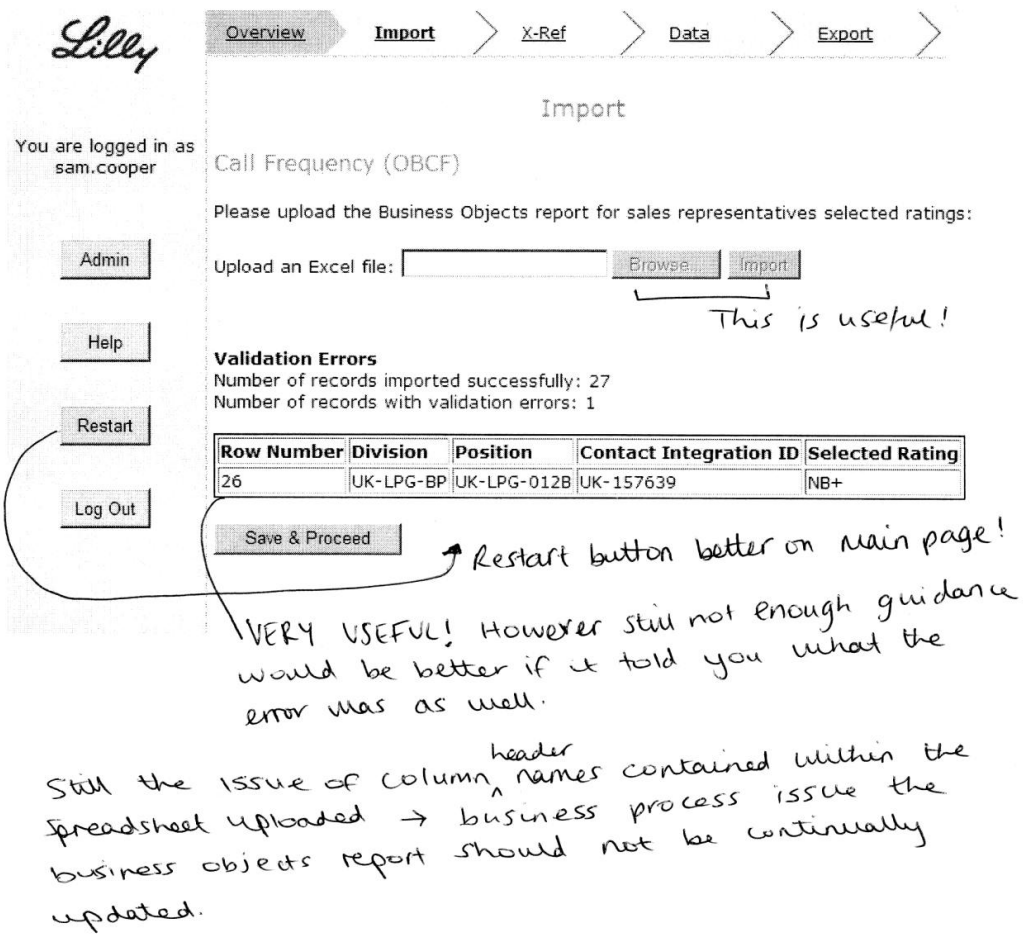


Figure 39. An example of user feedback during implementation

Although informal testing was completed throughout development, once the application had met all mandatory requirements and all users were happy with the interface design a final testing phase took place (the test plan can be seen in Appendix C: Section 3. The next section will now provide further details on this.

5.6 Testing

Testing is defined as "the process of exercising or evaluating a system by manual or automatic means to verify that it satisfies specified requirements or to identify differences between expected and actual results" [56]. This means that testing is the determination of how close to ideal the systems behavior is and any deviation indicates the presence of a bug.

As previously stated this project is developing the application as a proof of concept only and for this reason there was no need to follow a strict test plan. Testing still took place, but this was just on a smaller scale than that of a typical system. A draft test plan (which can be seen in Appendix C: Section 3) was created and participants were asked to perform these tasks at various stages throughout the implementation phase. This meant that testing was informally being completed throughout where the results and feedback being obtained from this testing were guiding the next stage of development (as described in section 5.5). Obviously if this system were to be fully integrated into the Lilly environment then a stronger test plan would need to be developed.

Examining the internal structure of the code to select test cases is known as white box testing, whilst examining the expected behavior of the code is known as black box testing. Exhaustive testing would include a test case for every possible path through the system, however this is impractical and instead the aim was to use black box and select a set of test cases as close to the ideal as possible.

5.7 Conclusion

This chapter has described the technical details of the development of the OneLilly targeting application including programming language choice, database design, system architecture, high-level class structure and further descriptions of the most significant functionality. The next chapter now focuses on evaluation and uses both empirical and analytical techniques to evaluate the new system.

Chapter 6

Evaluation

The two previous chapters have discussed the design process and methodologies used to implement the application, this chapter now brings all this together by completing a comparative evaluation between the existing and new system.

As Dix et al [1] states evaluation has three main goals:

1. **To assess the extent and accessibility of the systems functionality**: it must meet the user's requirements therefore meaning that the design should enable the user's to perform their intended tasks more easily
2. **To assess the user's experience of the interaction**: this may include aspects such as how easy it is to learn and use and the user's satisfaction.
3. **To identify any specific problems with the application**: this maybe aspects of the design which, when used in their intended context cause unexpected results or confusion amongst users.

However, a further goal is the compare systems to establish if there have been improvements made in the redesign. As noted in the literature review and discussed throughout chapter 4, evaluation occurs throughout the design process therefore the purpose of this chapter is to complete a final evaluation to assess the usability benefits of the final prototype compared to the existing system and ensure that all user requirements have been met by collecting information about users experience when interacting with each of them.

6.1 Evaluation activities

As discussed in the literature review (section 2.6) there are two general classes of evaluation methods: formative and summative. Formative has been used and discussed throughout the last two chapters whereas summative evaluation is completed within this chapter to assess whether the new OneLilly targeting application is better than the previous one, and if so estimate the degree of improvement and the implications for the workforce. As the literature review stated this evaluation can be done in a number of ways:

Empirical:

- Usability testing involves measuring typical users' performance on typical tasks. It is generally done by noting the number and kinds of errors that users make and recording the time it takes for them to complete a task. Questionnaires and interviews are also used to gather user opinions.
- Field studies are completed in natural settings with the aim of understanding how the prototype is adopted and used by users in their working and everyday lives.

Analytical:

- Cognitive walkthrough
- Heuristic evaluation
- Formal Evaluation

To ensure an effective evaluation this chapter will encompass all of these approaches and will be structured as follows:

- **Empirical Evaluation:** Empirical evaluation will include users completing specific measurable tasks in a representative working environment at Eli Lilly offices.
- **Subjective Evaluation:** This will enables users to give general feedback on the system, this will include informal interviews and questionnaires, the likert scale will be used.
- **Analytical evaluation:** A HCI expert will be asked to evaluate the new OneLilly targeting application

It is important to note that the empirical evaluation is actually an experimental manipulation because there is an independent variable (the system) being varied with the affects on the dependant variable being measured. However it will not be undertaken using a large number of users or in a laboratory setting. This experiment is a small-scale pilot study due to there being limited participants. The application has only four main users (each of which participate in the experiment) and it is not possible to recruit any more suitable users due to the fact that the experiment is within industry requiring users to participate during office hours. (Section 6.2.6 discusses participants in greater detail).

6.2 Experimental evaluation

The experiment is the primary means by which it is possible to establish cause-effect relationships between certain variables and the events that occur as a result of this. Johnson [42] states that designing HCI experiments involves the following steps:

1. Formulating a hypothesis
2. Developing predictions from the hypothesis
3. Choosing a means to test the prediction
4. Identifying all variables that might affect the results of the experiment
5. Deciding which are the independent variables (and levels of the independent variable), dependent variables and which variables need to be controlled by some means
6. Designing the experimental task and method

7. Subject selection
8. Deciding the experimental design, data collection method and controlling confounding variables
9. Deciding on the appropriate statistical or other analysis
10. Carrying out the experiment

Although this is only a small scale study it is still important to consider each of these steps for the experimental evaluation.

6.2.1 Hypothesis

A hypothesis is a testable statement that can be verified or falsified with an experiment. It is tested by manipulating one or more variables involved. The variable that is being manipulated is known as the independent variable because the conditions to test the variable are set up independently before the experiment starts, these will deliberately invoke a change in variables known as the dependant ones [2]. Murphy [41] states that the most common statistical procedure is to put a null hypothesis (H_0) against an alternative hypothesis (H_1). Null hypothesis usually refer to 'no difference' or 'no effect'. The aim of this experiment is to test the effect of the independent variable on the dependant variable; this is done by supporting a null-hypothesis.

Null-hypothesis (H_0): There is no difference between the new and existing interface.

Hypothesis (H_1): The new application developed for OneLilly targeting is superior to the existing system.

Thus the alternative hypothesis is directional if the null hypothesis has been rejected and the alternative is supported it will be possible to attempt to understand why this is the case. The results and analysis will then enable a discussion as to whether there is an impact on end user experiences after a navigational redesign.

The next section will consider what measurements need to be taken and what these mean to effectively complete the experimental design.

6.2.2 Measurements

To test the hypothesis it is important to consider what properties of the application would make it superior, these properties will then be those that are tested.

User preference is a clear property that will indicate this and the problem is that this is a very subjective measurement and alone will not allow the hypothesis to be tested. Therefore this needs to be divided further to collect quantitative data.

User preference will be influenced by the usability of the application. Section 2.6.2 of the literature review states some quantitative performance measures that can be taken to test usability. The most appropriate of these measurements will be used to form the experimental design. It is still possible to gather quantitative data on user preference for example using a likert scale where participants can specify a rating between 1 and 5 to specify their level of

agreement with a particular statement. Therefore additionally to performance measures user preference will be tested using the likert scale on a questionnaire.

It is now possible to develop predictions of what these measurements will show and consider how these predictions can be tested.

6.2.3 Developing predictions and choosing a means to test this

From the hypothesis a small number of predictions can be developed. Firstly the time to complete the task will be quicker than that of the existing system. This will primarily be due to the structural guidance through the task that the new interface provides. The use of breadcrumbs provides the user with a mental model of where they are within the system and how far they are through the task. The new application will be easier for inexperienced users to use due to this as well as the fact that a user does not need a technical understanding since everything is completed through the interface and no knowledge of SQL is required.

Furthermore data quality and integrity will be improved within the new application since it completes verification on behalf of the user both during the import phase as well as any edits that are completed by a user. This will lead to increased productivity and user preference for the new application. Finally as the new interface was developed using a participatory design approach users have already approved the new interface and so the prediction is that the new interface will be superior to the existing with the most significant factor being to due to easier task completion in reduced time.

There is a prediction that the number of clicks required for a user to reach their goal (successfully complete targeting data) will be reduced due to the navigational redesign. As stated in the literature review the use of breadcrumbs increases the usability by providing users with a mental model of their location within the site.

Predictions will be tested using a variety of methods as described in section 6.1. Notes and measurements will be taken throughout the experiment as well as it being recorded on a Dictaphone to capture all user comments. Measurements taken will include number and types of errors made, number of clicks to locate a specific piece of information and time taken. Notes will also be made on the path a user takes through the system. Finally participants will be asked to complete a questionnaire and be informally interviewed to discuss their feedback and comments.

6.2.4 Identifying variables

A variable is a measurable factor, characteristic or attribute of an individual or a system, it may be present or absent or take on a range of values at different times. To qualify as a variable two conditions must be met:

1. There is a general property or characteristic involved
2. The characteristic is measurable (it is important to specify the manner in which the variable is measured)

The variables that will be used within this experiment are shown in table 6.1:

Variable type	Description	Variables
Independent	Variable systematically varied by the experimenter	The IV is "the system" and has two levels: 1. The existing OneLilly targeting application 2. The new OneLilly targeting application
Dependent	Variable in which the participants performance is measured	Preference ratings Number and types of errors made per task Number of clicks to locate a specific piece of information Number of users completing a task successfully Time taken to complete a specific task

Table 3 Experiment variables

Data collected will be both qualitative collecting detailed information and quantitative which involves the analysis of numerical data. Together both data types will provide collective evidence to test the hypothesis.

A range of additional variables may exist which could affect the experiment, these include participant experience and mood, the time of day or the environment in which the experiment is completed within. Even the ordering in which the applications are tested could have an affect. Although these will not have an adverse affect on the results it is important to be aware and control them where possible. Johnson [42] states that the strength of an experiment depends on the experimenter's ability to guarantee that only the manipulated variables are permitted to vary systematically, if there is an uncontrolled variable varying along with the intended one it is known as a confounded variable. Many researches have suggested ways to deal with the effects of these variables, Keppel [43] states that the three most common ways (and many experiments include combinations of them all) are:

1. Hold the variable constant throughout the experiment
2. Counterbalance the variable by including all of its variables equally often in each condition
3. The systematic relationship between the confounding variable and the independent variable may be destroyed by randomisation.

For this particular experiment time of day and environment will be kept constant. The participant mood is the most difficult to control. One way to consider this is to link it in with the time of day; if experiments are completed at the start of the day participants would not have been pre-exposed to work related stress. The confounding variable of experience can be dealt with using counter balancing and matching. This can be completed by having an experienced user in each group and each group beginning with a different system (a greater discussion on this can be found in section 6.2.7).

6.2.5 Experimental task and method

This is a comparative evaluation therefore the experiment will consist of the same representative tasks being completed both within the existing as well as the new OneLilly targeting application. Participants will be asked to complete two main tasks, the first being the standard task of generating targeting data for a sales force, and the second task is designed to test the usability of each of the applications. This is done by asking the participant to complete a

variety of low-level tasks or actions for example navigating to a specific area or updating a call frequency value. Full details of each of these can be found on the participant instruction sheet in Appendix D: Section 1.

6.2.6 Participants

Johnson [42] discusses how it is the participants that provide a sensitive test of the research hypothesis. 'Sensitivity' is the ability to detect differences when they are present. It is possible to increase sensitivity when the number of participants is increased. Generally the minimum number of participants in a controlled experiment should be at least six. As previously stated during requirements (section 3.3) the OneLilly targeting application only has 2 main users and 3 additional users that could potentially be asked to use the application to support the main users. Four of these users are available to complete the experiment but this is not an issue since Dix et al [1] points out that the sample size should be large enough to be considered to be representative of the user population; therefore the number of participants in this case is not an issue and cannot be changed.

Finally it is important to note that only generalisations within this small population will be able to be made from the results since this is only a small scale pilot study.

The participants for this experiment shown in table 6.2:

#	**Role**	**Relation to OneLilly targeting application**	**Experience**	**Gender**
U1	OneLilly operational data steward	Primary user	Experience of all solutions	F
U2	Pharma IT – Business Integrator	Primary support of the application. Needs to be fully aware of its daily use.	Good experience of existing solution	M
U3	OneLilly business data steward	Secondary user	**Minimal** experience of the existing solution	F
U4	RADS* – Technical support	Supports the application from a technical perspective (e.g. where it is hosted & code developments)	**Minimal** experience: Only limited understanding of daily use of the system.	M

Table 4 Background of participants
(* Regional Applications, Development and Support)

The participants cover a range of roles and experiences, it is a very good representation of the users OneLilly targeting application currently has. It is possible to divide the four participants into two types: Experienced and Novice. This is important to be aware of when analysing the experiment results.

6.2.7 Experimental design and data collection method

The next step is to decide the experimental method to be used. There are a number of different experimental design methods that could be used, these include within, between and mixed groups designs which are all 'one-off' experiments. There are also longitudinal and cross-sectional studies which span over a greater period of time but due to time constraints the latter two will not be considered, although longer periods of study would give better learning rate data.

The two main design methods to consider are between-groups and within-groups, it is important to consider a number of factors before making the decision on which to use. Within-groups will use the same participants for all conditions. This experiment will have two conditions, one is the control factor which will be the existing system and the second will be the experimental treatment being the new system. Between-groups design will use different groups of participants in each condition, meaning that participants will receive only one of the different conditions. The advantages of between-groups design include the fact that they are simple to understand, easy to design and analyse and due to the fact that there are different participants transfer of learning effects is also prevented. Although it must be possible to match participants to reduce the effects of individual differences related to their experience. A limiting factor of between-groups is that it requires more participants meaning that this option has to be chosen when there are insufficient participants.

Sometimes it is necessary to complete a within-groups experiment since participants act as their own control, this enables a very good baseline from which to judge differences between the systems that does not relate to individual differences between the participants. It should be noted that there are ways to overcome these transfer effects, this could include giving participants a break or completing some other distraction task between the experiments, this will reduce the memory for transfer. Another option is to use counterbalancing where the two groups will complete the experiments in a different order. Although the experimenter should still be aware that it is possible to have asymmetrical transfer where transfer of learning from the existing system to the new system might not be the same visa versa.

It is also possible to consider the matched pair design, as with between-groups this involves the creation of two different groups but participants are matched on the factors that are considered to be important. This particular experiment an example of factors to match could include participant experience or ability.

Taking each of these factors into consideration it has been decided that the within-groups experimental design method will be used. The main reason being due to limited participants but also as stated this will also be beneficial since participants can act as their own control. The suggestion of counterbalancing will be used to prevent the transfer of learning effects. The four participants will be divided into two groups (each group will have both a novice and an experienced participant) one of which will experience the existing system first and one which will experience the new system first. This allocation is shown in table 6.3.

	Experienced	**Novice**
Existing system first	U1	U3
New system first	U2	U4

Table 5 Participant Allocation

This allocation also reduces the effect of a greater amount of experience as a confounding variable since each 'group' contains both an experience and novice user.

The data collection method will be through the use of questionnaires and written notes throughout the evaluation sessions (each of these can be found in Appendix D. For further analysis purposes recordings of both the experiments and interviews will be taken using a Dictaphone. A stopwatch will be used to record timings and these will noted on paper but also spoken into the Dictaphone as a backup recording.

6.2.8 Experimental results

The experiments were conducted across two days (26-27th March 2008) and were held at the Eli Lilly offices. All participants were given the same equipment set-up and brief before the experiment took place. Measurements taken are those described in table 6.2.2, furthermore non-statistical results were collected at the end of each experiment via informal interview.

Each measurement will complete additional calculations on each task, these include:

Mean (average): $\mu = \sum X / n$

Standard Deviation (spread of values): $\sigma = \sqrt{\sum (X - \mu)^2}$ / $n - 1$

Where X is the individual value (e.g. time taken) and n is the number of participants. This section will now discuss each measurement type and conclude by drawing all analysis together.

Time taken

The aim of this measurement is to measure how long it took each participant to complete individual tasks within both the old and the new system. The results are shown in tables 6 and 7.

Time Taken to complete task

		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	TOTAL
Experienced	U1	12.25	1.50	8.00	26.75	8.80	0.20	57.50
	U2	6.50	1.25	10.50	28.40	12.25	0.16	59.06
	Mean	9.38	1.38	9.25	27.58	10.53	0.18	58.28
	SD	4.07	0.18	1.77	1.17	2.44	0.03	1.10
Novice	U3	3.33	1.60	13.45	32.50	16.69	0.23	67.80
	U4	8.50	2.55	28.00	38.50	22.55	0.40	100.50
	Mean	5.92	2.08	20.73	35.50	19.62	0.32	84.15
	SD	3.66	0.67	10.29	4.24	4.14	0.12	23.12
	Mean	7.65	1.73	14.99	31.54	15.07	0.25	71.22
	SD	3.74	0.57	8.96	5.23	5.94	0.11	20.04

Table 6 Time taken using existing system

Time Taken to Complete Task (Minutes)

		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	TOTAL
Experienced	U1	1.25	2.00	2.90	4.25	0.23	0.22	10.85
	U2	0.26	2.50	2.30	2.90	0.16	0.18	8.30
	Mean	0.76	2.25	2.60	3.58	0.20	0.20	9.58
	SD	0.70	0.35	0.42	0.95	0.05	0.03	1.80
Novice	U3	0.43	2.12	1.15	3.56	0.20	0.40	7.86
	U4	0.53	2.00	1.45	5.45	0.22	0.16	9.81
	Mean	0.48	2.06	1.30	4.51	0.21	0.28	8.84
	SD	0.07	0.08	0.21	1.34	0.01	0.17	1.38
	Mean	0.62	2.16	1.95	4.04	0.20	0.24	9.21
	SD	0.44	0.24	0.80	1.09	0.03	0.11	1.38

Table 7 Time taken using new system

Further to this collection of data, figure 39 was produced to show the mean average time taken to complete each task.

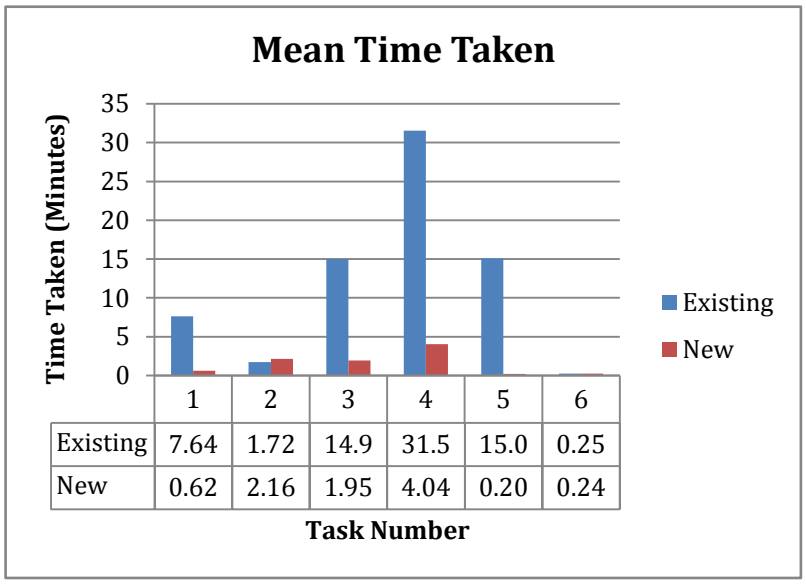


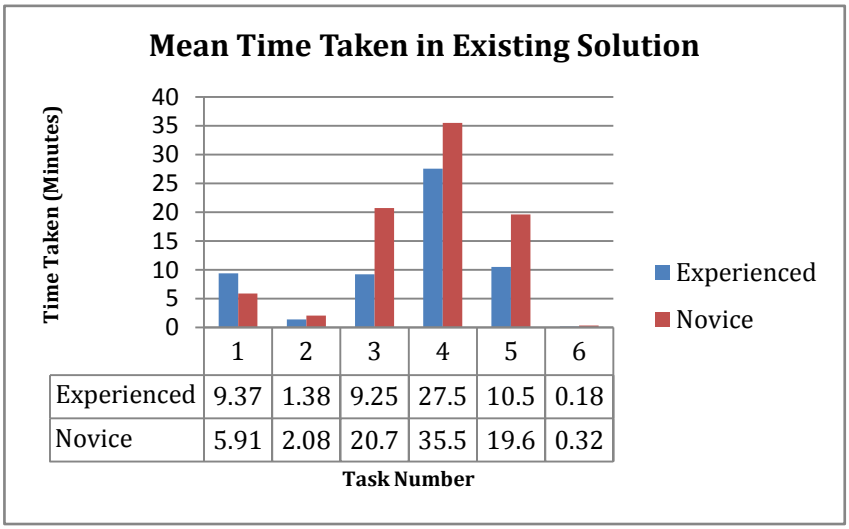
Figure 40. Bar Chart Displaying Mean Average Time

The most considerable aspect of these results is the total time taken between the two systems. Immediately it is possible to see that there is a vast improvement, with a mean total time taken of 71.22 minutes compared to 9.21 whilst using the new system. It can also been seen that the standard deviation is only 1.38 on the new solution compared to 20.04 on for the existing.

It is possible to highlight some of the interesting points about this set of results. Firstly it can be seen that as expected the most experienced user (U1) completed the task within the quickest time for the existing application. However note that she actually took the longest within the new system. The reason for this could be the fact that she knows the existing system in greater depth

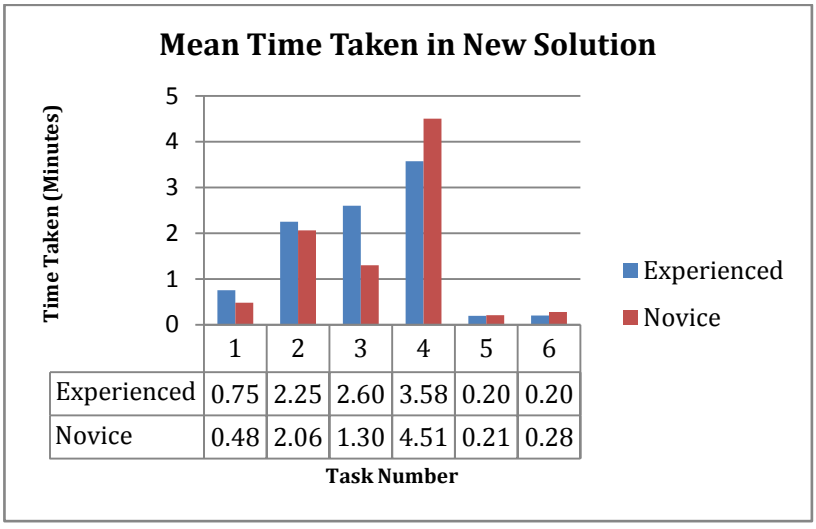
meaning that there has been a negative transfer of existing knowledge (that other participants wouldn't have had) to the new system. This meant that she had to unlearn the existing system as well as learn the new to a much greater extent than the novice users. During the interview it became apparent that she was trying to map how she completed certain tasks within the old system to the new one, whereas other participants do not have the existing knowledge to do this meaning they were able to complete the task in a quicker time.

Figures 40 and 41 show the difference between experienced and novice users.



	1	2	3	4	5	6
Experienced	9.37	1.38	9.25	27.5	10.5	0.18
Novice	5.91	2.08	20.7	35.5	19.6	0.32

Figure 41. Bar Chart displaying differences for experienced and novice users (existing system)



	1	2	3	4	5	6
Experienced	0.75	2.25	2.60	3.58	0.20	0.20
Novice	0.48	2.06	1.30	4.51	0.21	0.28

Figure 42. Bar Chart displaying differences for experienced and novice users (new system)

When comparing the results between novice and expert users it can be seen from figure 41 that in general novice users' took a greatest amount of time to complete each task within the existing system. If this is compared to figure 42 this is actually turned around such that in the experienced users took a greater amount of time at each task. Although the exception being at step 4 (verifying) where novice took longer this could be due to experienced users being more familiar with the data and checks required.

Another highlighting aspect of U1 results is the time taken to complete the first task (the overview or preparation of data), when this was discussed during the interview she commented that she takes her time at the start to check all variables thoroughly. She described that from her experience spending greater time checking at the start prevents errors running through the task and saves her time in the long-run. This would make sense since a novice user would not be aware of what potential errors could occur and therefore what they should be checking, so they will simply complete the task and move on.

It can be seen that task 4 (verifying generated data) in the existing system takes significantly longer than the rest of the tasks. As shown as part of the observation in chapter 3 and comments from interviews, data integrity and validation was an issue due to the fact that the system did not have any built in validation and it allowed a user to freely access and edit queries. This is a key area that has been improved within the new system since users have restricted access and all data is validation on import and during user editing. This has provided users with more confidence in the data integrity which has led to the reduced verification times shown within this results set. This was also complemented with user comments in the follow-up interviews, one participant commented "since it is not possible to edit a query it means the generated data will always follow the standard process – If I were to use this system over a greater period of time I would become familiar with those fields I no longer need to check e.g. date format".

Looking at the standard deviations it is possible to see that they are much larger for the existing system. This would have been assumed and expected due to the fact that the timings will differ significantly between the experienced and novice users. Experienced users have found workarounds and become familiar with tasks that would have taken novice users longer to complete.

Number of errors made

The aim of this measurement is to understand where and what type of common errors users experienced between the two systems. Any action that causes the user to remove something (e.g. delete an incorrectly inputted value) or re-iterate over a particular task (e.g. re-run a query) will be noted as an error.

The number and type of errors made throughout all experiments were noted (these are shown in table 8) and the number of errors made are summarised within tables 9 and 10.

#	Within Existing	Within New
U1	T2: Accidentally let Access chose a primary T3: Used a keyboard shortcut to run but clicked the wrong one	T3: Didn't realise you need to select from drop-down box, thought everything within it would be assigned to that position
U2	T1: Written delete query incorrectly T2: Did not select tick-box for first rows as column names T2: Inserted into a new table instead of existing T3: Incorrectly spelt product T3: Did not remove duplicate rows T3: Missed the 'INVALID' fields in the remaining columns T4: Incorrectly copied data to template (put into wrong sheet) T4: Macro within external template failed (there	T1: Didn't select the 3 data types needed T3: Chose incorrect objective (didn't know more could be added)

	were less rows than last time ran meaning there were null's) – verification could not be completed T5: Exported from Access but did not understand how to export to correct format using the template	
U3	T1: Written delete query incorrectly T1: Did not run the query (just saved it instead) T2: Let Access chose a primary key T6: Clicked Export only (participant thought this would send it as well)	None
U4	T1: Forgot to update SQL to the correct quarter T2: Imported the incorrect worksheet T2: Let Access chose primary key T3: Spelt the indication incorrectly T3: Did not remove duplicate rows T4: Accidentally re-ran the query instead of opening the table of data generated T5: Exported the incorrect table (forgot to run the distinct query first)	T2: System only looks at first worksheet – but data was within second so nothing was imported T5: Exported one data type instead of all

Table 8 Types of errors made

Number Of Errors Made

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	TOTAL
U1	0	1	1	0	0	0	2
U2	1	2	3	2	1	0	9
U3	2	1	0	0	0	1	4
U4	1	2	2	1	1	0	7
Mean	1.00	1.50	1.50	0.75	0.50	0.25	5.50
SD	0.82	0.58	1.29	0.96	0.58	0.50	3.11

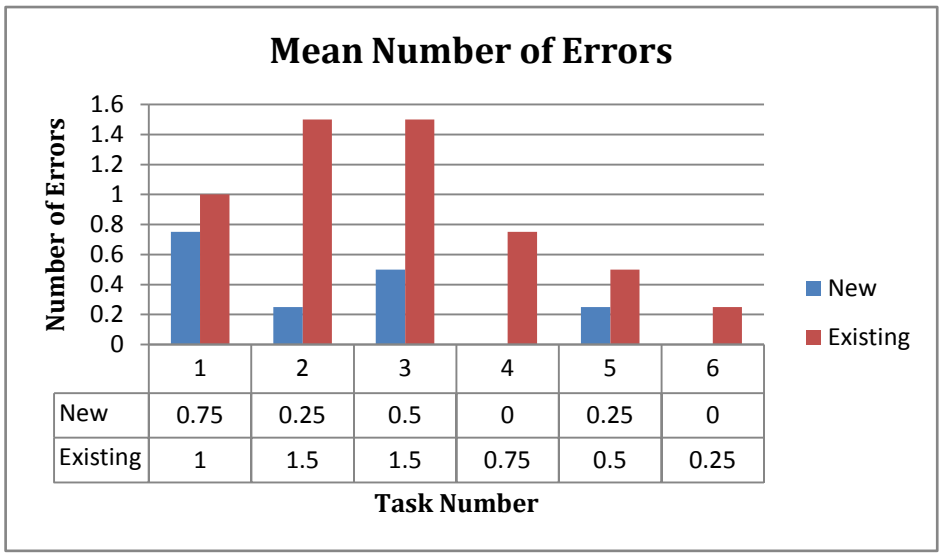
Table 9 Number of errors made using existing system

Number Of Errors Made

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	TOTAL
U1	0	0	1	0	0	0	1
U2	3	0	1	0	0	0	4
U3	0	0	0	0	0	0	0
U4	0	1	0	0	1	0	2
Mean	0.75	0.25	0.50	0.00	0.25	0.00	1.75
SD	1.50	0.50	0.58	0.00	0.50	0.00	1.71

Table 10 Number of errors made using new system

Further to this collection of data, figure 43 was produced to show the mean number of errors made for each task.



	1	2	3	4	5	6
New	0.75	0.25	0.5	0	0.25	0
Existing	1	1.5	1.5	0.75	0.5	0.25

Figure 43. Bar Chart displaying the mean number of errors

The most considerable aspect of these results is the clear reduction in the number of errors for the new system with no errors being made in both tasks 4 and 6. Also note how the standard deviation is again reduced for the new system, this continues to support the assumption that the users' performance is better whilst using the new system.

It is possible to categorise these errors into two main types: **Validation** (where the system should prevent the user from completing this particular action) and **insufficient guidance** which has led to users lacking understanding in terms of not being aware of what actions are possible, or where they should or can move onto next. Such errors have been reduced through the use of breadcrumb navigation within the new system.

Between all users there were 22 errors made within the existing system, the majority of these should not be possible. Nielson's guideline for 'Error prevention' states that error prone conditions should be eliminated thus errors like incorrectly spelt products and indications can (and have been within the new system) eliminated by using a drop-down preventing an incorrect spelling to be made. The same concept is relevant for manually written queries or table set up (setting primary keys), within the new system all technical aspects are now hidden and completed automatically.

The remaining errors (mainly by inexperienced users) fall into the category of insufficient guidance and included errors like incorrectly moving data or being unaware of how to run a query or export data. As Nielson states having help and documentation maybe necessary but it should be kept short and focus on particular tasks, as the design chapter discusses the help function within the new application follows this guideline by using videos specific to each step. This functionality (along with the fact that everything is now contained within one system) prevented such errors occurring in the new system. Comments from inexperienced users showed that help functions and guidance are no longer as important since the system structure supports them better than the existing system. One particular comment stated "I don't need to understand the fact that a query is being ran, all I need to do is click to view my data" [57].

Quotes such as this show how the new system no longer requires a technical understanding being required meaning users do not need to rely on help and documentation as much.

Reviewing the errors that were made within the new system is important to check that there are not any remaining usability problems. An interesting error made by the experienced user was her assuming that everything in the drop-down list was assigned to the position, she did not realise that she had to select items During the proceeding interview this error was discussed and her comments showed that she was still relating her understanding to the existing system. She stated "I am just used to manually entering everything, so at first a drop-down box just confused me" [58]. Since this error did not occur in other participant's behaviour it is possible to assume that it was her previous experience that caused this rather than a usability problem.

Participant 2 (U2) commented that her first error was just a simple mistake and she realised that she was not paying enough attention to the information on screen, she was able to easily navigate back to re-select the tick-boxes. Her second error was due to the objective she wanted to select was not in the drop-down box, once she was told a new one can be added by an administrator she stated that this should be made clearer on the screen (or she should have be made aware of this beforehand). Participant 3 made no errors within the new system and participant 4's error was due to data being contained within the wrong worksheet (second instead of first), therefore an error would have occurred whichever system was being used. It was seen that although this error could have been prevented by allowing the user to chose which worksheet their data is in, this could also have opposite effect of confusion to what this means (as has happened in the existing system).

The final error made whilst using the new system was that only one data type was exported rather than all, the participant commented that since he has now experience of the task he did not realise that all was required and he simply clicked the first link on the page. During discussions it was mentioned that an improvement might be to add helpful comments, for example 'This will open a file containing business plan data in the OneLilly format' to this screen (although it is useful to note that this is discussed in the help video).

Number of clicks

This experiment was conducted to investigate the general usability and to attempt to answer the question of whether navigational redesign has an impact on end user experiences by lowering the number of commands and eliminating tedious message prompts and unnecessary clicks. To assess the efficiency of the interaction design the number of clicks were recorded. These results are taken from part 2 of the experiment. Participants were asked to locate a specific piece of information or complete a simple task within the application. Results are shown in table 11.

Note: The instruction sheet (see Appendix D: Section 1) listed 4 tasks but the results do not contain data for the final task, the reason for this is because it is not possible to edit an individual record within the existing system meaning it is not possible to complete the comparison for this particular task.

Number of Clicks						
	Existing			New		
	Task 1	Task 2	Task 3	Task 1	Task 2	Task 3
U1	3	4	11	1	2	4
U2	2	12	17	1	2	6
U3	5	7	21	1	2	4
U4	2	4	28	1	2	4
Mean	3.00	6.75	19.25	1.00	2.00	4.50
SD	1.41	3.77	7.14	0.00	0.00	1.00

Table 11 Comparing the number of clicks required

Again further to this data collection, figure 44 was produced to show the mean number of clicks required to reach their goal.

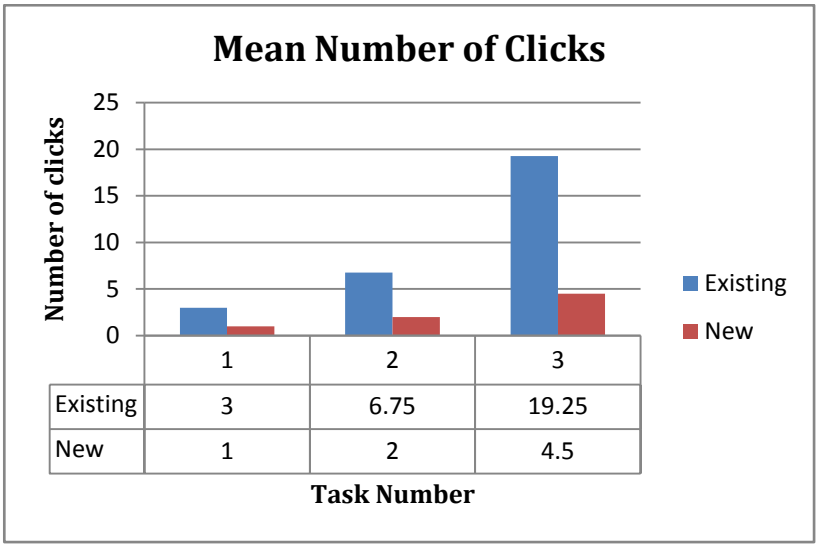


Figure 44. Bar Chart displaying the mean number of clicks

Although it should be noted that this is a small selection of tasks it is possible to see that generally a participant was able to reach their goal quicker/easier using the new system. As figure 6.3 shows the most significant difference is task 3 (updating the cross reference), the main reasons for this difference is due to the fact that within the existing system the user is required to manually delete existing data and re-run queries. In the new system this is completed automatically when the save button is clicked.

Again it is possible to see that the standard deviations are larger for the existing system, but one of the main differences for this particular measurement is that both tasks 1 and 2 within the new system have a standard deviation of zero. Although as previously noted this is a small selection of tasks and participants but this data is supporting evidence and therefore a good indication that the usability has been improved through the navigational redesign.

6.3 Subjective user evaluation

After completing the experiment each participant was asked to fill-in a questionnaire which included 7 questions using the likert rating scale. The final question involved an informal interview to gather the participant's general opinion on the new system. Due to time constraints these interviews were conducted on the telephone the day after the experiment took place (to assist participants remember their experiences both systems were being used during the telephone conversation). Written notes and completed questionnaires can be found in appendix D: sections 2 and 3.

The Questionnaire contained the following statements and asked users to provide a rating for the new and the existing system (Using a scale of 1-5 with 1 being strongly disagree and 5 being strongly agree):

1. I found it easy to complete the first task
2. I found it easy to complete the second task
3. I found it easy to locate the call frequency data
4. I didn't need to rely on a user manual or help functions
5. I find the system easy to navigate through
6. I found it easy to update the cross-reference table and subsequently the data set
7. I found it easy to edit the data produced

The questionnaire scores can be seen in tables 12 and 13.

	Responses						
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
U1	3	3	4	3	2	2	1
U2	1	1	3	1	2	1	2
U3	2	3	4	3	1	3	1
U4	1	1	2	1	1	1	1
Mean	1.75	2.00	3.25	2.00	1.50	1.75	1.25
SD	0.96	1.15	0.96	1.15	0.58	0.96	0.50

Table 12 Questionnaire responses for existing system

	Responses						
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
U1	4	5	5	4	5	4	5
U2	4	4	4	4	5	5	5
U3	5	5	5	5	5	4	5
U4	5	5	5	4	5	4	5
Mean	4.50	4.75	4.75	4.25	5.00	4.25	5.00
SD	0.58	0.50	0.50	0.50	0.00	0.50	0.00

Table 13 Questionnaire responses for new system

Figure 45 is a bar chart displaying the mean scores for both systems.

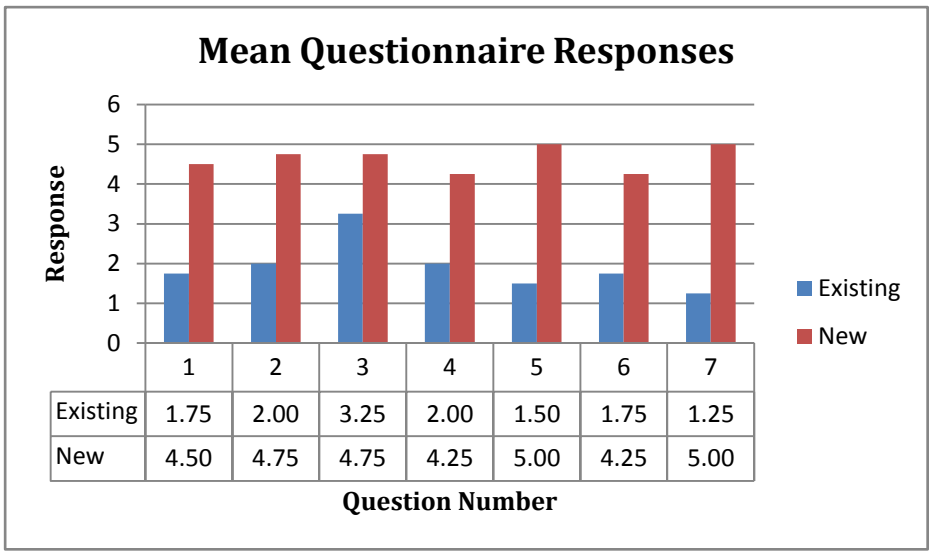


Figure 45. Bar chart displaying likert scale scores

Figure 45 clearly shows a change in user preference with responses to questions 5 and 7 all at 'strongly agree'. An important fact to note is that even the most experienced user (U1) still rated the new system higher than the existing.

Having analysed the discussions raised it is possible to categorise them into two sections: Interaction and context.

Interaction

Every participant discussed how to navigate around the new system and progress towards task completion. Comments such as "I like knowing how far I've got through the task" and "the bar across the top made locating the cross-reference so much easier when I needed to make a change" were raised [57]. These provide good supporting evidence that the impact of navigational redesign through the use of breadcrumbs was successful. Although whilst referencing the annotated screen shots from the implementation section (see appendix C: Section 2) during the telephone conversation [58] there were some additional comments and suggestions raised, these included:

- It is not immediately obvious that the breadcrumbs are clickable; one participant thought it was just a "display of your status". It was suggested that the text should be blue (meaning the breadcrumb design should no longer be green).
- When verifying data the breadcrumbs do not change, one participant suggested that there be another status bar that pops up below that updates as you work through each data type. (This would also require a save button at the end of each data type).
- It was suggested that there is a 'Finish' breadcrumb that they should be redirected to once they have sent the final file. The participant also suggested that if they click the cross or log-out they should be prompted/reminded to send the file.

Another good point to note is that 3 of 4 participants discussed how the new system is structured in the same way as they 'think'; comments such as "I like how steps are more clearly defined" and "the system guides me through" [57]. Reasons for such comments are due to not only the use of breadcrumbs but also because when the user clicks save at each stage the system automatically redirects them to the next step. Comparing these comments to those that were raised during the requirements gathering (see section 3.3.4) it is possible to see a significant change in user opinion.

Finally another common discussed aspect was the change in user confidence; this has been increased due to a number of reasons:

- Verification during import
- Since there is no technical knowledge required participants commented "I don't need to worry about whether I made a mistake when editing the query"
- The validation that is completed whilst editing produced data

The new system restricts some functionality to administration users only, there were mixed comments about this since it was stated that the lack of flexibility affects the usability since they are unable to change the objective details themselves. The main (experienced) user stated that this was required whereas supporting users stated that this could waste time if the main user was away and data needed to be completed urgently. The main discussion point was adding additional objectives to the drop-down box but as the main user pointed out this is not going to be a frequent occurrence and if this was the case they would be notified well in advance. This discussion is focused around a change in the roles and responsibilities of the job rather than the software. It is useful that the software allowed this discussion to go ahead assisting the company to make business process decisions.

A further enhancement to the administration functionality was also suggested: Adding an additional role (rather than just admin and user) to include those that can edit generated data and those that can only view. This would be useful when sharing data to the sale force before it is complete. It was therefore decided that the administration functionality was useful and should remain in place.

Finally discussions arose around the screens displaying generated data; comments included the need to scroll far to the right hand side to see all columns. Users had different opinions on this, some stated some of the 'static' columns could be removed and only displayed when the data is exported to Excel. Other participants liked being able to see everything, it enabled the user to verify everything within one screen. Considering both of these comments an additional enhancement might be to have a button to allow a switch between two different types of views. This discussion also led onto how the data is divided such that only 10 records are displayed per screen, participants commented that this is useful but had comments on how this could be

improved by following the standard of their global CRM system. Participants stated that it would improve the usability since they would immediately know how many records (and pages) there are. Figure 46 and 47 show the difference.

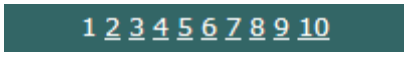


Figure 46. Current paging structure

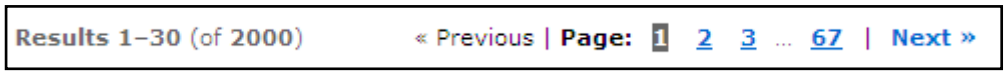


Figure 47. Requested global system paging structure

Figure 46 shows page number only and this could become very large with significant amounts of data, therefore as figure 47 shows usability can be improved with the addition of number of pages along with 'Previous' and 'Next'.

Context

Every participant made a comment about the fact that the new system does not require them to have any technical knowledge and how much time and effort it saves not having to work these details out. Comments such as "Just being able to select the quarter from a drop-down box is so much easier than having to understand how and where to update the SQL" were made.

In terms of functionality there were a number of key areas that participants were particularly impressed by:

- The verification on import, comments like "Its fantastic that I don't need to worry about errors moving through each stage" [57]
- The information provided when there is an import error is extremely useful to users
- Being able to verify, edit and export data from within the tool saves users a lot of time

Overall participants were very happy with the functionality that this prototype provided them with. The main comment was that currently the tool is only for the LPG sales force and if it were to be put to its full use the main enhancement would be to extend it to all sales forces.

There were also some suggestions for usability improvement:

- The results from the import verification could provide more information, e.g. the nature of the error rather than just its location.
- It would be useful if the position column on the cross reference table was sort able
- Having statistics on the export page to inform the user of how many of each data type they will be exporting and sending (this was also raised during the requirements phase but was secondary priority).

Some suggestions for enhancements:

- Currently one of the major issues in any system that is used is if the selected ratings spreadsheet is changed. Within the old system each column and title had to be precise in order for it to load, the system has a slight improvement such that columns can now be in any order but the column titles still need to be exact. A suggested further improvement is to extent the implementation to directly query and obtain the data from the secondary system rather than running a report and loading.
- Extending the system to include National sales managers as well as sales representatives

If these interview comments were compared to those raised during the requirements phase it is possible to see a change in user attitude. For example the following quotes can be compared:

"I am extremely worried that if I do the slightest thing wrong I will have to start again" (requirements interviews 30/11/07)

"It is fantastic that I don't need to worry about errors moving through each stage" (Post-evaluation interview 28/03/08)

This example along with other quotes has shown a positive attitude towards the new system with comments focused on navigational guidance and improved robustness.

Participants also commented on how useful it is that the new system generates business plan data as well (previously this had to be manually completed externally). Every participant also commented on how all functionality is now within one application without the need to copy and paste data into the template. Comments such as "It was easy to make mistakes when moving data, the new system provides you with more confidence" and "It's so much easier when its all together" show that there is a preference for the new system.

6.4 Expert evaluation

As discussed in section 6.1 this section is an analytical evaluation method, it requires analysts or usability experts. As discussed by Faulkner [10] it is a good idea to use a combination of both methods so the final part of this evaluation will be an expert heuristic evaluation. As stated within the expert evaluation within the requirements chapter, this method would usually require multiple evaluators but due to time constraints and expert availability this will not be possible and so a single evaluator will be used.

Interview with: Jon Bolt HCC Masters Student

Jon is completing an MSc in Human Communication and Computing at the university of Bath. Jon has also gained experience within industry whilst completing a placement abroad.

Jon was presented with the new OneLilly targeting application and in relation to Nielson's guidelines (section 2.3) he discussed his thoughts on the new interface.

The majority of comments that Jon raised fitted into Nielson's fourth guideline, consistency and standards. Due to the fact that the screens were designed solely from user sketches some standards were not followed, these included the design of hyperlinks, breadcrumbs, button design and colour matching. The standard for hyperlinks is blue and underlined but the new

system simply underlines the text only, Jon discussed how this could prevent users from immediately recognising that the text is clickable.

Jon commented that although he cannot see any issues with the current breadcrumbs, he suggested it might have been more sensible to follow the standard for breadcrumbs (as shown in figure 48).

Figure 48. Standard breadcrumb design

He also commented on the good aspects of the systems breadcrumbs, these included how it is useful that the current page is displayed in bold and previous pages are shaded green to indicate they are completed (as shown in figure 49).

Figure 49. Breadcrumb design

Again his comments touched on how hyperlinks need to be standard; this is because it is not immediately obvious that the breadcrumbs contain links. Even if the user was aware that they are links, the green shading could 'fool' users into thinking that the pages are no longer accessible since they are completed (this was also raised and discussed during the user comments in the interaction of section 6.3). If these links were to become blue then it would also be a good idea to change the breadcrumb colour design and Jon commented that if possible the most sensible choice would be make it consistent with the corporate standards.

Button design and colour matching was also mentioned, the current design has green buttons on the left-hand side menu but Jon commented that firstly buttons are not usually green and secondly it would be more appropriate to use a standard design for this type of functionality, this would be to use hyperlinks rather than buttons. Although this comment in valid for consistency with standard systems, it would not be comment taken forward for this particular system. This is because the design decisions were made solely by users and therefore the interface is customised to their preferences.

The discussion then moved onto navigation, Jon suggested that to make the fact that users are able to navigate back more explicit there could be an additional 'Back' button next to the 'Save & Proceed' button on each screen. He also pointed out that when you are within each separate screen for data the breadcrumbs are broken since the 'Data' tab is not in bold thus potentially confusing users.

Another navigational suggestion that Jon made was in relation to a user accessing the help videos; to reach them users need to navigate away from their current location and task, this could potentially lead to confusion when returning. His suggestion was to move each help video to the relevant page making it clear that it is a video and not written instructions (since this might encourage them to view it more). This comment was also raised by a user (See annotated screens in Appendix C: Section 2) therefore this feature would be changed if there were to be another development iteration.

The discussion also highlighted the fact that users may ignore and therefore not even notice the functionality contained within the left-hand side menu, the suggestion was to move the restart button to where it would be required (import screen). This again was raised by users also (Appendix C: Section 1) so again would be an additional change to make. This therefore leaves only basic functions like the logout contained within the left-hand menu.

A final suggestion that Jon made was to only display the admin links (both the button on the right hand side and the link on the cross reference page) to admin users only. Although currently if an admin user attempts to access it they receive an informative error message Jon suggested it would be better to remove the functionality entirely. This is a valid point and if the system were to be taken forward this feature would be added in.

6.5 Conclusion

This chapter has completed an informed evaluation by focusing on three key areas: Empirical involving a small-scale study, subjective to gather user opinion and analytical where a HCI expert was asked to perform discount usability evaluation. Each technique has provided different but complementary data to comparatively evaluate the new system against the old. Results and discussions have also enabled the question of whether breadcrumbs as a navigational aid have improved end user experiences.

To conclude the section will begin by relating back to the hypothesis:

Null-hypothesis (H_0**):** There is no difference between the new and existing interface.

Hypothesis (H_1**):** The new application developed for OneLilly targeting is superior to the existing system.

Through each of the evaluation methods and results described throughout this chapter it is possible to reject the null hypothesis and find sufficient evidence from a variety of sources (both qualitative and quantitative data) to accept the alternative hypothesis. It is possible to make the conclusion that the new OneLilly targeting application is superior to the existing system and through analysis and discussions throughout this chapter it is also possible to say that the approach adopted to improve navigational efficiency was successful.

Although as stated throughout the evaluation this was a small-scale study only since there were limited participants available. Further studies would need to take place to be able to draw more extensive conclusions but clearly not possible with target population as they are limited in numbers.

In the next and final chapter of this project, conclusions will be drawn about the development of the new OneLilly targeting application, what has been achieved and whether the objectives stated at the beginning have been met. This chapter has already suggested some improvements and potential further developments but the final chapter will summarise and extend upon these.

Chapter 7

Conclusions

The aim of this project was to evaluate and redevelop the OneLilly targeting application with particular attention to improving the navigational efficiency through the user interface. The research aim of the project was to investigate how navigational design can influence user experiences.

The question to now consider is whether the aim and objectives stated in chapter 1 have been achieved. To answer this question, this chapter will explore what has been achieved by discussing the main learning's from the project and an analysis of whether the research aim has been met. The chapter will then move onto a discussion of potential enhancements or future work which could be undertaken to extend the development and finally concluding by discussing ideas for improving or moving the current research forwards.

7.1 Project Overview

This project comprises of six chapters which encompass the different stages undertaken to achieve the redevelopment of the OneLilly targeting application. Now follows a summary of each of the chapters.

Chapter 1, Introduction provided a background for the project and discussed how it had both an academic and industrial foundation. It stated the aims and objectives of the project and discussed which research areas would be considered.

Chapter 2, Literature review provided a background understanding of the key factors, principles and methodologies in user interface design and development using a user-centred approach. The chapter began with a summary and discussion of human computer interaction (HCI) principles and the design considerations needed to support these principles. The chapter then went onto consider user-centred design tasks and usability evaluation. This chapter also highlighted some of the current research impacting navigation design decisions including concepts such as information scent and latent semantic analysis.

Chapter 3, Requirements began by providing an overview of the targeting process and focused on gathering requirements from the stakeholders using a variety of techniques including interviews, observations and task analysis. This chapter concludes by providing a prioritisation list and the resultant requirements specification.

Chapter 4, Design used a variety of participatory design techniques to allow informed user interface design decisions to be made. Design activities included iterative low-fidelity prototyping, CARD using storyboarding, creating an envisioned HTA and iterative higher-fidelity prototyping. This chapter used the QOC (Questions , Options and Criteria) notation to record all design decisions that were made.

Chapter 5, Implementation described the technical details of how the findings from previous chapters were used to develop the new OneLilly targeting application. It began by giving an introduction to the .NET framework and discussing why ASP.NET was chosen as the development environment. It then moved onto an exploration of a recently added extension to the framework: language-integrated query (LINQ) which proved to be particularly useful for this implementation. The chapter also described the database set-up, class structures and provide detailed descriptions of how the main features were implemented.

Chapter 6, Evaluation focused on three key areas: Empirical involving a small-scale study, subjective to gather user opinion and analytical where a HCI expert was asked to perform discount usability evaluation. The chapter concluded by relating back to the hypothesis to discuss whether the new application developed for OneLilly targeting is superior to the existing system.

A summary of the project outputs will now be given.

7.2 Project Outputs

Throughout the project document the question of whether navigational redesign impacts end user experiences has been considered; this investigation was the primary research aim of the project. Through stakeholder's choice it has been possible to implement and therefore investigate breadcrumbs as a solution. Participatory design was utilised as a methodological tool successfully within the development process. This section will now draw conclusions by summarising the results of the theoretical, empirical and practical work completed during the project.

7.2.1 Theoretical

The project has given a good insight into the current research areas impacting navigation design. The initial research gave an introduction into how the navigational structure has a direct impact on how users typically forage for information, and therefore how quickly or easily they reach their goal. Design lessons for information scent were stated by Nielson [14] and were considered throughout the design. An investigation into current research surrounding the usage and effectiveness of breadcrumbs as a navigational aid also took place. It was clear that many

researchers have different opinions of their utility meaning that currently it is still inconclusive as to the importance of breadcrumbs as a contextual aid. During the design phase of the project users made the decision to use breadcrumbs as the navigational aid in the new system, this therefore provided the opportunity to further demonstrate or extend the current research in this area.

Throughout design and implementation phases, user discussions and conclusions shaped the design of the breadcrumb navigation. Design decisions such as colouring, for pop-out and status reasons, and item ordering for task sequencing reasons was particularly important in meeting requirements related to providing guidance through the task but at the same time allowing flexibility. Small status details such as shading to demonstrate progress through the task to aid location understanding had to be reconsidered to ensure previous breadcrumbs were still seen to be clickable. During research and experimentation of such designs some key findings were highlighted:

- Keep the navigation as simple as possible with minimal links (during the design phase, one particular user attempted to add every action to the breadcrumb items, this design was rejected by remaining users due to its complexity and potentially preventing flexibility).
- Consistency is important such that the same navigation structure appears on every page (this was found to be an issue when the administration page initially had a slight variant in the structure – this was changed as a result of user feedback)
- It needs to be clear that breadcrumb items are clickable
- Each breadcrumb item should use short, clear and precise words that are familiar to the user
- Keep similar links together (It was seen that only links relating to the task formed part of the breadcrumbs, remaining links such as accessing help or administration were contained in the left menu)
- Allow for flexibility (For this project this was particularly relevant and as highlighted within the literature the interface must allow the users to recover from errors. As seen earlier this included allowing the user to return to a previous section to make corrections)
- Where possible provide the user with information on their current location (this decision came out during design where the decision was made to make the current link bold)

Chapter six provided evidence that the implementation of breadcrumbs as a new navigational design was effective in supporting the user to complete their task, guiding their 'journey' through the task, and as a result the null hypothesis was rejected. The evidence found within this project has advanced the state of the current research on navigation to show that with user involvement during design will have a positive effect on the usage and effectiveness of breadcrumbs. User choice to include breadcrumbs and the users' role in design were possibly pivotal in realising a positive impact of breadcrumb design features.

7.2.2 Empirical

The empirical project output is the observable evidence from the evaluation. As stated within the chapter six conclusions, there was sufficient evidence from a variety of sources to conclude that the new targeting application is superior to the existing system. The supporting data included time taken, number and types of errors made and number of clicks required to reach a specific location or goal. A reduction in the number of clicks required in the new system shows that the navigational structure was used to quickly and effectively support the user

(questionnaire results also corroborated this). The number of errors was reduced and again from questionnaire results it can be seen that this was due to the improved navigation design (user comments stated how the breadcrumbs guided them through the task so they were aware of what their next actions should be). In conclusion this shows that the results were obtained as a result of the new navigational structure.

7.2.3 Methodological understanding

Participatory design techniques were encouraged throughout the project lifecycle in a number of ways. During requirements analysis, interviews encouraged stakeholder interest in the project and enabled users to easily provide all of their comments on the existing system. A card-sorting session also took place, thus allowing users to discuss and conclude specific reasons for their task sequencing choices. The results from this fed into requirements and began the discussion of navigation design.

During the design phase users were recruited to the design team and participated throughout. To begin users completed low-fidelity prototyping to design the UI, this was followed by group discussions to elaborate and share ideas. A number of options were selected, discussed and conclusions began to be made. Finally users took part in a CARD (see section 2.5.3) session, this was to aid the navigational design decisions. Participatory design techniques continued throughout implementation where users were available to give feedback, at each iteration.

The process of user-centred design has shaped the project and as a result of giving users the opportunity to engage in hands-on activities they have happily and immediately adopted and made use of the new system. Therefore, on significant success of the project is that the software is now being used on a daily basis in the commercial setting for which it was designed.

In general, using participatory design techniques ran smoothly throughout the project. However on occasion there were a limited number of comprehension and communication issues both between the author and between the end users themselves. These resulted from the fact that not all the stakeholders and the project author could physically meet to discuss every small change in the implemented design and electronic means was utilised instead for such feedback needs. Therefore as a recommendation if such a user-centred project were to be completed again it would be sensible to set up a shared-collaboration area where discussions and information could be held in one place rather than using email communication.

7.2.4 Practical

The practical project output is the successful redevelopment and deployment of the OneLilly targeting application. This is a fully functional prototype which is now in use at Eli Lilly and during company testing was successfully used to generate targeting data for this quarter. The software has provided the company with significant business benefits with the most substantial difference being increased productivity due to the amount of time the system saves. Some of the additional benefits users described the system as bringing included:

- Reducing the overhead on the business data stewards since no technical knowledge is now required to complete the task.
- This also reduces the overhead on IT staff since tedious help and training on Access is no longer required.

- The data quality and integrity will also be significantly improved leading to a reduction in load errors (again leading to increased productivity).
- The process has been simplified now that all aspects of the task are completed within one system

7.3 Future Work

This section will consider further work to the OneLilly targeting application including potential enhancements or additional features mentioned by users during the empirical evaluation. Finally concluding with a discussion on how the current research may be moving forward.

7.3.1 System Further Enhancements

As stated in section 3.9 the project was scoped to complete implementation for just a single sales force this was due to limitations of implementation time. Therefore the most significant further extension would be to expand the application to all eight sales forces. Due to the fact that the system was developed externally to the company there were also some limitations for the export functionality, this included the ability to place completed files onto the shared server requested and loading the file to the OneLilly server.

In terms of future work for the application many suggestions were made during empirical evaluation. The issue that seems to cause the most difficulty is the business object report that to be loaded into the application, the existing system required columns to appear in an exact order with precise column names. Within the new application this was improved such that columns could now appear in any order but still exact column names are required. This causes user frustration since loading errors occur frequently due to the business objects report continually being updated. Although this could be considered a business process issue such that the report could be prevented from being updated a user suggested adding functionality which automatically queries the correct server to obtain the data required therefore cutting out the report generation and loading phases.

Further enhancements were those that were discussed during requirements analysis or stated as secondary priorities but weren't implemented, this includes:

- Providing specific information on load errors
- Providing extensive statistics
- Auditing functionality to track changes and monitor data sent

Many user interface design enhancements were suggested and these were discussed in greater detail during iterative high-fidelity prototyping and again during evaluation (see sections 4.5 and 6.3)

7.3.2 Research Moving Forward

The web provides access to an unparalleled volume of information and this will continue to expand with an increasing amount of web-based information technologies being introduced. The ways in which people produce, find, and use information are rapidly evolving which means that the field of information retrieval is far from being a "solved problem". Navigation directly

impacts information retrieval and developing interfaces to effectively support this is likely to be a significant research area moving forward.

With the trend towards increasing ubiquitous computing and the emergence of mobile devices, this affords the opportunity for investigating navigation design from a new perspective. Much existing research has considered the usage of navigational aids based on the size and positioning on the page, but what are the implications for mobile devices with small screens? Is there enough room for navigational aids? If they are hidden will users be aware of their existence? Increasingly standard websites are becoming available on smaller screens, but is it possible to navigate in the same way? These questions are likely to be those that are considered in future research.

Finally, how navigation supports searching is a crucial research theme. Today's retrieval systems support common functions for everyone regardless of who, where or what the individual is or looking for. Such systems are being used by an increasingly diverse population for increasingly diverse tasks. Research in the future is likely to design and evaluate how interfaces and navigation can be improved to understand and respond to individual user needs.

The project has been of great success and has benefited both the company and the author understanding, as well as considering and enhancing current research.

Bibliography

Books

[1] Dix et al, 2004, *Human-Computer Interaction* 3rd ed. Pearson, Prentice Hall

[2] Preece et al, 2007*, Interaction design* 2nd ed. Wiley & son

[3] M.Rosson and J.Carroll, 2002, *Usability Engineering*. Academic Press

[4] Shneiderman and Plaisant, 2005, *Designing the user interface 4th ed.* Pearson Education

[7] D.Schuler and A.Namioka, 1993, *Participatory Design.* LEA publishers

[10] C.Faulkner, 1998, *The Essence of Human-Computer Interaction.* Prentice Hall

[11] J.Nielsen, 2000, *Designing Web Usability.* New Riders Publishing

[41] K.Murphy, 2004, *Statistical analysis.* Lawrence Erlbaum Associates publishers

[42] P.Johnson, 1992, *Human Computer Interaction: Psychology, Task Analysis and Software Engineering.* McGraw-Hill Book Company

[43] G.Kepple & T.Wickens, 2004, *Design and Analysis. A Researchers Handbook.* Pearson, Prentice Hall.

[44] Sommerville, 2004, *Software Engineering Seven*. Pearson, Addison Wesley.

[56] E.Stiller & C.LeBlanc, 2002, *Project-based software engineering.* Addison Wesley.

Conference proceedings

[5] J.Nielson & R.Molich, 1990. *Heuristic Evaluation of User Interfaces*. CHI '90 Proceedings

[8] G.Grinstien, A.Kobsa, C.Plaisant, J.Stasko, 2003. *Which comes first, usability or utility?* Proceedings of the 14th IEEE Visualization Conference

[12] W.Hudson, Oct 2004. *HCI and the web: Breadcrumb Navigation.*

[13] H.Chi, P.Pirolli, K.Chen, JPitkow, Mar 2001. *Using Information Scent to model user information needs and actions on the web.* CHI Proceedings

[15] Allan D.Saja, Jan 1985. *The cognitive model: An approach to designing the human-computer interface.* SIGCHI

[16] N.Bevan & I.Curson, May 1999. *Planning and Implementing User-centred design.* CHI 99' proceedings

[19] Muller, Mar 1991. *Participatory design in Britain and North America.* Reaching through technology CHI '91

[20] C.Spinuzzi, Oct 2002. *A Scandinavian Challenge, a US Response: Methodological Assumptions in Scandinavian and US Prototyping Approach.* SIGDOC 02.

[21] H.Henderson, Apr 1990. *Reflections on participatory design.* CHI 90' proceedings

[22] M.Kyng, Apr 1994. *Scandinavian Design: Users in product development.* Human factors in computing systems.

[23] J.Aberg & N.Shahmehri, *An Empirical study of human web assistants: Implications for user support in web information systems.* CHI 2001 proceedings.

[24] B. Shneiderman, May 2000 *Universal usability.* Communications of the ACH

[26] S.Frimm, Jan 1988. *A User needs approach to context-sensitive help.* ACM SIGCHI

[27] M J.Muller, June 1992. *PICTIVE – An exploration in participatory design.* Proceedings of the SIGCHI conference on human factors in computing systems CHI '92

[28] M J.Muller, M.Wildman & A.White, June 1993. *"Equal Opportunity" PD using PICTIVE.* Communications of the AC, volume 3 pg 64-66

[29] M.Muller, T.Dayton & L.Gayle, 1993. *A C.A.R.D game for participatory task analysis and redesign.* Conference in human factors in computing 93'.

[30] S.Bodker & O.Iverson, Oct 2002. *Staging a professional participatory design practice – Moving PD beyond initial fascination of user involvement.* NordiCHI conference on human-computer interaction 2002.

[31] J.Hughes, V.King, T.Rodden & H.Anderson, Apr 1995. *The role of ethnography in interactive system design.* Interactions Volume 2, Issue 2, ACM Press.

[32] H.Lichter, S.Hufschmidt & H.Zullighoven, May 1993. *Prototyping in Industrial Software Projects – bridging the gap between theory and practice.* Proceedings of the 15th International conference on Software Engineering ICSE '93.

[33] C.Floyd, 1984. *A Systematic look at prototyping.*

[34] J.Rudd, K.Stern & S.Isensee, Jan 1996. *Low Vs. High-fidelity prototyping debate.* Interactions volume 3, Issue 1. ACM Press.

[35] L.Gayle Tudor, M.Muller & T.Dayton, Apr 1993. *A C.A.R.D game for participatory task analysis and redesign: Macroscopic complement to PICTIVE.* INTERACT '93 and CHI '93 conference companion on human factors in computing systems.

[36] C D.Ryan, Dec 2001. *The Human Computer Interface: Challenges for educational multimedia and web designers.* SIGCSE, Vol 33. Number 4.

[37] R.Macfarland, 1995. *Ten design points for the human interface.*

[38] V.Bellotti, A.Maclean & T.Moran, Oct 1991. What Makes A Good Design Question? ACM SIGCHI Bulletin

[39] A.MacLean, R.Young, V.Bellotti & T.Moran, Sept 1991. Questions, options, and criteria: elements of design space analysis. HCI volume 6, pg 201-250.

[45] PIROLLI, P., CARD, S.K., 1999. Information foraging. *Psychological Review,* 106(4), pp.643-675.

[47] KATZ, M.A, BYRNE, M.D., 2003. Effects of Scent and Breadth on Use of Site-specific search on E-Commerce Web Sites. *ACM Transactions on Computer-Human Interaction*, 10(3), pp.198-220.

[48] DUMAIS, S.T., 1988. Using Latent Semantic Analysis to improve access to textual information. *Proceedings of the Conference on Human Factors in Computing Systems CHI'88.*

[50] B.Lida & S.Hull, 2003. Breadcrumb Navigation: An exploratory study of usage

[53] MALDONADO, C.A., PESNICK, M.L., 2002. Do common user design patterns improve navigation? *Proceedings of the human factors and ergonomics 46th annual meeting.* Baltimore, September, 2002, pp.1315-1319.

[54] HUDSON, W., 2004. Breadcrumb navigation: There's more to hansel and grettel than meets the eye. *Interactions,* 11 (5), September-October 2004, pp.79-80. New York: ACM Press.

Web-based

[6] J.Nielson, 2005. Severity ratings for usability problems [online]. Available at: http://www.useit.com/papers/heuristic/severityrating.html

[9] J.Nielson, 2005. Introduction to usability [online]. Available at: http://www.useit.com/alertbox/20030825.html

[14] J.Nielson, 2005. *Information foraging* [online]. Available at: http://www.useit.com/alertbox/20030630.html

[17] University of Washington (usability research group). *User centred design methods* [online]. Available at: http://www.indiana.edu/~usable/presentations/ucd_methods.pdf

[18] Alison Black, Nov 2006 *User centered design* [online]. Available at:

http://www.designcouncil.org.uk/en/About-Design/Design-Techniques/User-centred-design-/

[25] Jing Wu, Apr 2000. *Accommodating both experts and novices in one interface* [online]. Available at: http://www.otal.umd.edu/UUGuide/jingwu/

[46] NIELSON, J., 2003. Information foraging: Why Google makes people leave your website faster [online]. Available from: http://www.useit.com/alertbox/20030630.html [Accessed 12.04.08]

[49] INSTONE, K., 2002. Location, Path and Attribute breadcrumbs. [online]. Available from http://instone.org/files/KEI-Breadcrumbs-IAS.pdf [Accessed 12.04.08].

[51] BERNARD, M., 2003. What is the best way to arrange menus? Criteria for optimal web design (Designing for usability). [online] Available from: http://www.optimalweb.org [Accessed 12.02.08]

[52] ROGERS, B.L., CHAPARRO, B., 2004. [online]. Available from http://psychology.wichita.edu/surl/usabilitynews/61/breadcrumb.htm [Accessed 12.04.08].

[55] NIELSON, J., 2007. Breadcrumb navigation increasingly useful. [online] available from: http://www.useit.com/alertbox/breadcrumbs.html [Accessed 12.04.08]

Personal Communications

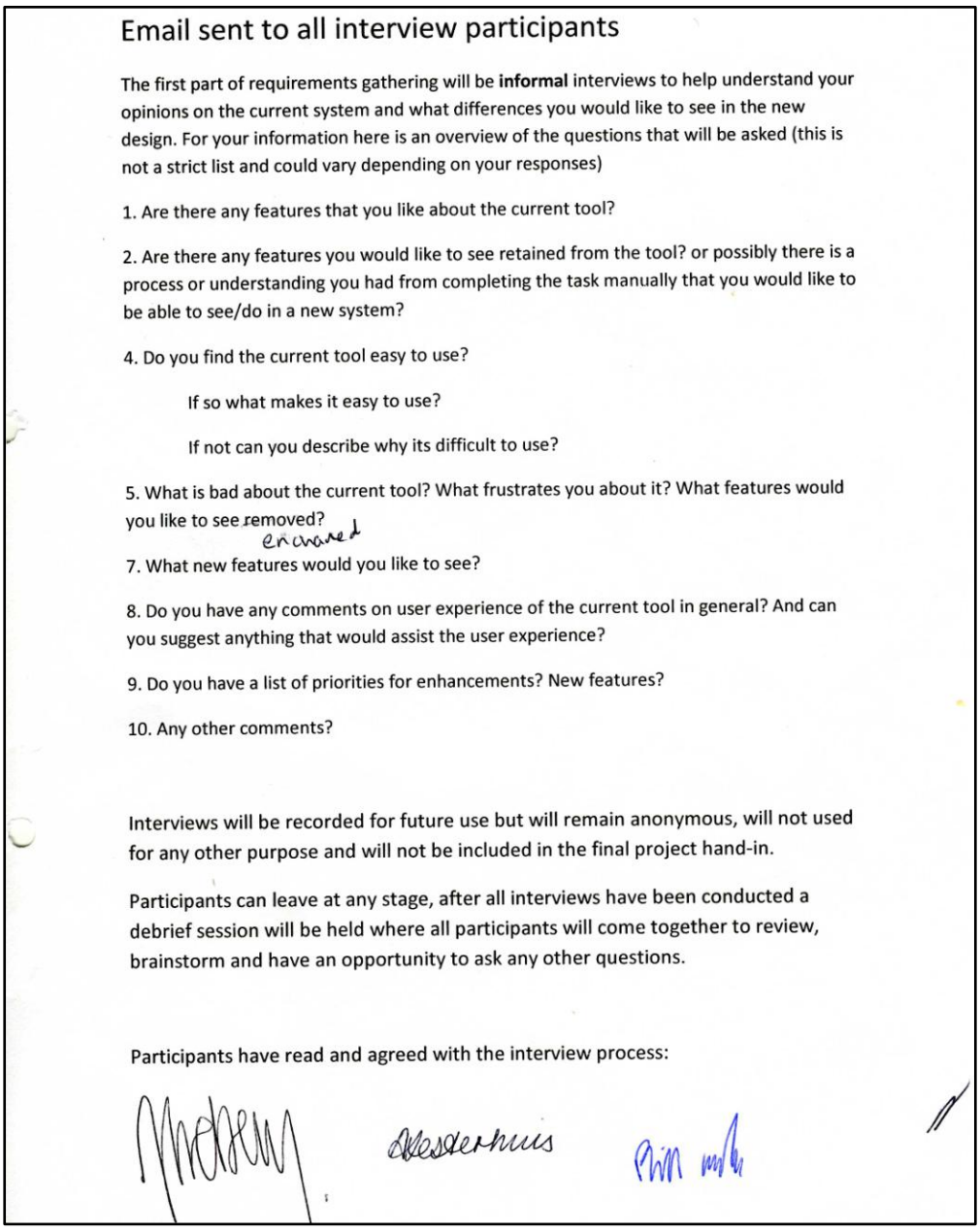
[40] N.Lindsay & N.Langley, 01/04/08 11:30-12:00: Telephone communications discussing design options

[57] C.Goddard, 28/03/08 14:30-15:00: Telephone communications following-up from evaluation session.

[58] N.Lindsay, 31/03/08 09:00-09:30: Telephone communications following-up from evaluation session.

Appendix A: Requirements Supporting Documentation

Section 1: Interview Transcripts and signed copy of email sent to participants



Email sent to all interview participants

The first part of requirements gathering will be **informal** interviews to help understand your opinions on the current system and what differences you would like to see in the new design. For your information here is an overview of the questions that will be asked (this is not a strict list and could vary depending on your responses)

1. Are there any features that you like about the current tool?

2. Are there any features you would like to see retained from the tool? or possibly there is a process or understanding you had from completing the task manually that you would like to be able to see/do in a new system?

4. Do you find the current tool easy to use?

If so what makes it easy to use?

If not can you describe why its difficult to use?

5. What is bad about the current tool? What frustrates you about it? What features would you like to see removed?
enhanced

7. What new features would you like to see?

8. Do you have any comments on user experience of the current tool in general? And can you suggest anything that would assist the user experience?

9. Do you have a list of priorities for enhancements? New features?

10. Any other comments?

Interviews will be recorded for future use but will remain anonymous, will not used for any other purpose and will not be included in the final project hand-in.

Participants can leave at any stage, after all interviews have been conducted a debrief session will be held where all participants will come together to review, brainstorm and have an opportunity to ask any other questions.

Participants have read and agreed with the interview process:

Interview Transcript

Date: 30/11/07

Interviewee name and team: Operational Data Steward (main user of the tool) N.L

1. What is <u>good</u> about the current system? Are there any features you like about the current tool?

- way in which extract files from what sales reps have entered into Oneline, <u>VERY</u> useful functionality → its good that this can be directly imported to the tool
- BuildRating2Objective → functionality of this query. like the way in which it checks the data is valid (since its an open field for sales representatives to type into.)

<u>ALTHOUGH</u> this query usefully builds the x-ref (between value sales rep chooses & the objective they will now be given) problem is that it adds values to bottom instead of checking ④pro

2. Are there any features you would like to see retained from the tool? Or possibly there is a process or understanding you had from completing the task manually that you would like to be able to see/do in a new system?

- Ratings2Objectives, want to be able to still manually edit the x-ref
- End result, files generated automatically in correct format
- Excluding invalid data automatically
- Validation - still very manual process but can be useful

3. Do you find the current tool easy to use?

- Need a good understanding of <u>precisely</u> what format the data needs to be provided, if data provided incorrectly (in terms of format) system currently will not accept it

If so what makes it easy to use? If not can you describe why it's difficult to use?

- Need a high technical understanding to be able to navigate around the tool & manipulate SQL code easily as required

Need to alter SQL code for
→ date quarters
→ if cols outputted need to be changed, e.g moving from ver① to ②

- You have to delete all old records before you create/build new ones. user likes idea of being able to keep a history of old data (just one would be enough). user likes to be able to see how it was done previously as a prompt to remember how to do it. as a work-around she currently re-names a table

from Q1

what values are already contained in the table. Extra work required by user to check validity.

- like the fact that files are generated automatically &
- it excludes any invalid values

ALTHOUGH user is not informed of how many records (or which) were invalid, suggestion of additional feedback required here to inform user.

- look & feel of tool → user says is much better than the manual method (lots of Excel spreadsheets)

BUT can be very complicated, SQL code visible & difficult to understand.

When & if you get error messages can be difficult to understand, difficult to navigate.

↳ e.g. col names didn't match, had to get assistance to understand and update this.

Error messages could be more informative
user suggested being able to understand what is a problem with the system & problem with data, difficult to distinguish at the moment

Q3 continued

Although this has called issues since Access then automatically updated table name, v. unhelpful & then had to go in & edit code to fix

- Navigation extremly difficult to follow, always needing to switch between tables & queries.

Everything has to be done in exact order otherwise it won't work e.g. ran OBJT query but failed since OBCF hadn't ran yet, there were no error messages, user said she would have liked to have been informed its not possible to run this query yet, (this doesn't make sense because in loading you should load OBJT and then OBCF, but they are created in the opposite order).

- Also the look/feel & instructions vary slightly between different divisions, can be confusing

4. What is bad about the current tool? What frustrates you about it? What features would you like to see removed?

- More info on error
- Many different databases (but still want to be able to do one division at a time)
- Navigation very hard
- SQL access & Manipulation
- very unreliable everything has to be precisely correct for it to work
  e.g. name was printed incorrectly because the SQL code didn't take into account varying length division names.
- x-ref just adding to bottom + edit
  user states that she still wants to be able to see this x-ref, to check but also due to business changes.

5. What new features would you like to see?

- Validation of the final output
  - possibly incorporating telling user how many records need to be validated (currently this is done externally) & then randomly selected that amount of records to verify
  - Checks on data like date format, position & division match i.e. not possible to have a LPG rep with a HFR division system should know many days in each month, & which months belong to which divisions
- Exporting reduce number steps (there is also a small error with character at end of file) ⊛ pto

6. Do you have any comments on user experience of the current tool in general? And can you suggest anything that would assist the user experience?

very quick compared to manual process detail
once you got your head around every precise, training & steps it is possible to use, but need a lot of support for when goes wrong
Its very easy to make mistakes
NOT a good user experience for new users; users wouldn't even know where to start

7. Do you have a list of priorities for enhancements? New features?

1. Everything currently does in terms of functionality
Smooth existing functionality, easier to use, better help, guidance by new users
2. validation
3. verification
4. Sending data to server

8. Any other comments?

No

Q6 continued

- have feedback on stats
  i.e. how many records were finally produced split into record type

Interview Transcript

Date: 30/11/07

Interviewee name and team: Business integrator

A.L

1. What is good about the current system? Are there any features you like about the current tool?

look & feel

- Its familiar, Access is a common tool & consistent with other microsoft products users are used to, navigation consistent across.
- supported product (although Lilly recommend it shouldn't be used any more, due to large db's data protection etc).
- It can be used offline

2. Are there any features you would like to see retained from the tool? Or possibly there is a process or understanding you had from completing the task manually that you would like to be able to see/do in a new system?

- functionality for removing invalid
- functionality for checking loaded data, looking for unique values
- functionality for generating the x-ref ready for user to update

3. Do you find the current tool easy to use?

If from an IT back ground and have had training currently the interface is largely SQL driven which means users need to be familiar in order to get desired results

If so what makes it easy to use? If not can you describe why it's difficult to use?

Its currently limiting its users, lots of training & documentation is required. No user-guidance at all within the tool.

No amount of training can assist to quickly & easily describe how to build a query, requires pre-knowledge of I.T

it would be good to move away from this & have a much more of a usable interface for non-usual ~~techies~~ users,

& have help built into the system. Tool should help user rather than user directing tool... could be a good idea to have equivalent to a "shopping cart" navigation/status at top informing user of their current status/state/step within the task (*) PTO

Q3 continued

user needs to know process, & tool is to facilitate process, but it should be the reverse. System follows the process & doesn't allow user to run an incorrect query, instead it is guiding the user through each step

4. What is <u>bad</u> about the current tool? What frustrates you about it? What features would you like to see removed?

- very difficult to know where your at, (esp if go to get a cup of tea!)
- its not intuitive to use / navigate around always really need to be thinking exactly what your doing, every small action needs to be precisely correct

5. What new features would you like to see?

- Not having to re-write queries each time
- Have a single system (not multiple db's)
- Nice easy to use interface to load business object reports
- Better feedback of errors
- functionality added for statistics of generated records
- reports
  - stating which records were invalid, & who selected them (which rep)
  - which positions have targetted
- Have help built into the system
- Better usability in terms of navigation
- log-on screen ☺ pto.

6. Do you have any comments on user experience of the current tool in general? And can you suggest anything that would assist the user experience?

See question 5

7. Do you have a list of priorities for enhancements? New features?

8. Any other comments?

Q5 continued

user describes ideal

- introductory screen - log on
- choose division
- chosen positions + divisions check → could be a report to verify before proceeding onto creation

BASELINE
XREF → it goes off & do it

- provide it with all info it needs to tell the user what it plans to do

"make the tool 'think' like the user would

user guidance in tool → to allow anyone (with background knowledge, not IT) to use tool

→ checking e.g. you've provided symbolta & 5 ratings

→ think about exporting process

→ verification within tool

↳ user go 'deeper' into data if a problem is noticed be able to view detail of each field & edit

If a problem is found have ability to go back rather than have to start again ↳ change easily

- ability to cancel throughout

ability to save at each step

security, logging onto system (particularly if data is being sent automatically).

↳ rules on characters etc in p/w

depends whether stand-alone or not online

integrate with existing Lilly p/w's? LSSO

potentially integrate with Lilly's intranet - WSS

history of what you loaded and when

Audit trails for apps e.g. user1 logged on at 1236 and completed this

or files/data that are produced (although might not needed if stand-alone)

↳ although need to think about management of this since might get huge overtime

Interview Transcript

Date: 30/11/07

Interviewee name and team: Business integrator - direct, first hand support for tool.

P.M

1. What is good about the current system? Are there any features you like about the current tool?

- like the fact that you can see SQL + then diagramtic view of the query, useful for 'fixing', drag & drop etc.
- Access is familar
- much quicker than manual process
- It looks for unique values to validate data from the business objects report..

2. Are there any features you would like to see retained from the tool? Or possibly there is a process or understanding you had from completing the task manually that you would like to be able to see/do in a new system?

All functionality

3. Do you find the current tool easy to use?

no, although familiarity of the software, Access

If so what makes it easy to use? If not can you describe why it's difficult to use?

only easy through experience

4. What is bad about the current tool? What frustrates you about it? What features would you like to see removed?

- building a new database for each division
- difficulty in trying to work out what you need to change to re-use a database for the next objectives & quarter if you only miss one thing it will all break

5. What new features would you like to see?

- removing the invalid's earlier on in the process
- Rather than loading in a business objects report, take data directly from other system
- looks for duplicate records earlier on
- currently theres no way to check that we have all objectives we need, so if a rep is in a particular position there should be objectives set, maybe you could query on people with positions & then compare this to output to ensure that all occupied positions are with objectives
- potentially be able to 'save your state', currently its easy to walk away & when come back have no idea where your at

6. Do you have any comments on user experience of the current tool in general? And can you suggest anything that would assist the user experience? (R)PTO

- user not seeing SQL, "hidden" shielded.
- VB to cover up details
- Easier admin, ie due to release structure input files might change, so will need to be able to add / change outputted fields easily
- Easier to add BO reports useful if people do different parts.
- Help throughout task.
  - ↳ videos? hoover over, 'hidden help' help for each box input bar where you (text that explains stage your at)

7. Do you have a list of priorities for enhancements? New features?

→ existing functionality with nice UI

↳ verification

↳ validation

Statistics

8. Any other comments?

- To be able to handle all record types for objectives
  Sales quota + time management
  Business plans for all
- Admin area
  - adding new users
  - updating info etc

Section 2: OneLilly Objective Input Specification

Data: Objective
Record Type: OBJT

	Input Format						
	Ref. to DD	**Field Name**	**Max Length**	**Required**	**Format**	**Integration ID**	**Default Value**
Input System Fields	n/a	Affiliate Code	2	✓		□	□
	n/a	Record Type	4	✓		□	□
	n/a	Source System Id	30	✓		□	□
	n/a	Operation	1				
	n/a	Operation Date	15				
Input Data Fields	1009	Name	100	✓		□	□
	1011	Type	30	✓		□	□
	1012	Description	1000	✓		□	□
	1014	Start Date	15	✓	YYYYMMDD HHMISS	□	□
	1015	End Date	15	✓	YYYYMMDD HHMISS	□	□
	1017	Status	30				
		Target	1000			□	
		Business Plan Name	100			□	
		Summary	1,000			□	
		Locked flag	1	✓		□	
		Geography Name	50	□		✓	
		Primary Position Flag	1	✓		□	
	1025	Position Name	50	✓			
		Position Division	100	✓			
		Report Flag	1	□			
		LLY_Local Start Date	15	✓	YYYYMMDD HHMISS		
		LLY_Local End Date	15	✓	YYYYMMDD HHMISS		

Data: Objective Time Management
Record Type: OBTM

	Input Format						
	Ref. to DD	**Field Name**	**Max Length**	**Required**	**Format**	**Integration ID**	**Default Value**
Input System Fields	n/a	Affiliate Code	2	✓		□	□
	n/a	Record Type	4	✓		□	□

	n/a	Source System Id	30	✓		□	□
	n/a	Operation	1				
	n/a	Operation Date	15				
Input Data Fields		Type	30	✓		□	□
		Days	22,7	□		□	□
		Target Calls Per Day	22,7	□		□	□
		Ratio	22,7	□		□	□
		Comments	255	□		□	□
		Parent Objective Name	100	✓			

Data: Objective Sales Quota
Record Type: OBSQ

	Input Format						
	Ref. to DD	**Field Name**	**Max Length**	**Required**	**Format**	**Integration ID**	**Default Value**
Input System Fields	n/a	Affiliate Code	2	✓		□	□
	n/a	Record Type	4	✓		□	□
	n/a	Source System Id	30	✓		□	□
	n/a	Operation	1				
	n/a	Operation Date	15				
Input Data Fields		Parent Objective Name	100	✓		□	□
		Product Id	30	✓		✓	□
		Primary Product Flag	1	✓		□	□
		Currency	20	✓		□	USD
		Sales Quota	22,7	□		□	□
		Unit Quota	22,7	□		□	□
		SoM Quota	22,7	□		□	□
		Percentage	22,7	□		□	□

Data: Objective Call Frequency
Record Type: OBCF

	Input Format						
	Ref. to DD	**Field Name**	**Max Length**	**Required**	**Format**	**Integration ID**	**Default Value**
Input System Fields	n/a	Affiliate Code	2	✓		□	□
	n/a	Record Type	4	✓		□	□
	n/a	Source System Id	30	✓		□	□

	n/a	Operation	1				
	n/a	Operation Date	15				
Input Data Fields		Contact Id	30	✓		✓	□
		Parent Objective Name	100	✓		□	□
		My Suggested Rating	30	□		□	□
		My Selected Rating	30				
		Customer Call Frequency	10,0				
		My Suggested Call Freq	30			□	
		My Call Frequency	10,0			□	
		My Reason for Difference	100			□	
		Product Id	30	□		✓	
		Indication	30			□	

Data: Business Plan

Record Type: BSPL

	Input Format						
	Ref. to DD	**Field Name**	**Max Length**	**Required**	**Format**	**Integration ID**	**Default Value**
Input System Fields	n/a	Affiliate Code	2	✓		□	□
	n/a	Record Type	4	✓		□	□
	n/a	Source System Id	30	✓		□	□
	n/a	Operation	1				
	n/a	Operation Date	15				
Input Data Fields		Name	100	✓		□	□
		Type	30	✓		□	□
		Description	1000	□		□	□
		Start Date	15	✓	YYYYMMDD HHMISS	□	□
		End Date	15	✓	YYYYMMDD HHMISS	□	□
		Locked flag	1	✓		□	
		Parent Business Plan Name	100			□	
		Primary Position Flag	1	✓		□	
		Position Name	50	✓			
		Position Division	100	✓			
		Status	30	□			
		LLY_Local Start Date	15	✓	YYYYMMDD HHMISS		
		LLY_Local End Date	15	✓	YYYYMMDD HHMISS		

Section 3: User Instructions for the Existing solution

How to re-use a targeting tool

All databases can be found in the following location:
\\Ybsvr10\uk onelilly\Work In Progress\Samantha Cooper\Q3 2007 Objectives

1. Data steward to extract data
2. Open required database and delete all old data
    a. Go the query section and select new
    b. Click ok where it says design view, then click close when it prompts you to add a table
    c. On the top left hand side click 'SQL' and then type the following into the box:

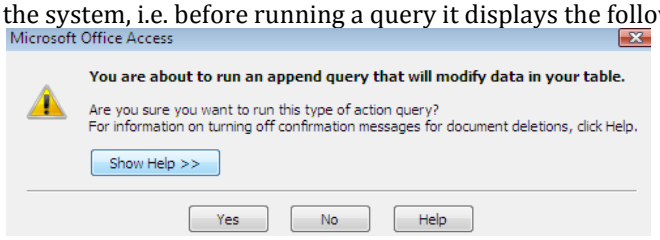
    ```
    DELETE SelectedRatings.* FROM
    SelectedRatings;
    ```

    d. Click run (the red explanation mark on the top menu)
    e. Click yes when it asks you if you are sure
3. Import your new data
    a. File->Get external data->Import
    b. Locate and open your new file
    c. Follow through the wizard making sure you insert into existing table (SelectedRatings). There is no need for a primary key.
4. You now need to make sure you are happy with the X-ref
    a. Bearing in mind that the MySelectedRatings field is free text reps are therefore able to select anything they want! So you need to make sure your X-ref is updated to check which reps have selected invalid. Therefore the best way to do this is re-run the 'Build Rating2Objective' query.
    b. You will see another prompt just click yes
    c. Now open the table Rating2Objective. You will see that additional records have now been added to the bottom (these records are the distinct selected ratings)
    d. Now what you need to check is that there aren't any additional selectedRatings, if there are then make sure you add 'INVALID' all columns
    e. Then remove any rows that already exist above.
    f. You should now have an up-to-date X-ref
5. In the tables section delete any old copies of OBCF_ONELILLY and OBJT_ONELILLY
6. In the query section run the 'Make OBCF_ONELILLY' query by double clicking it
7. click yes at the two prompts you will see
8. You will now have an OBCF_ONELILLY table in the table section, it is a good idea to go and have a look in here to make sure you are happy with it and do some brief checks.
9. Once you are happy you can now export this table (right click->export->saving the type as Excel)
10. Now you need to run the 'Make OBJT_ONELILLY' query, do this by double clicking it
11. There should now be a table 'OBJT_ONELILLY' in the tables section, check and export this table as before.

Please note: Not all databases have **exactly** the same naming conventions for the tables/query but they will be very similar so you will be able to work it out. I didn't have time to go and make them all consistent.

Section 4: Notes taken during expert evaluation of existing system

Following through each step Jason encountered numerous usability issues as well as some parts of the system where it displayed a good example of usability. These have been categorized into Nielson's heuristics:

Heuristic	Comments
Visibility of system status	Difficult to know where to go once system has loaded, there is no defined start or completion screen. Many times throughout the system there is a lack of feedback for example once a SQL query has been ran it does not inform the user it is complete. Due to the amount of data the system could produce without the visibility of the user, the system should provide summary information to make sure the user is aware of what the system has produced.
Match between system and real world	Users are unable to see what data is being removed since they are required to write an SQL query to delete rows. This is a concept that is not familiar with non-technical users, it should match the 'real world' in terms of viewing, selecting and deleting data through an interface.
User control and freedom	There is no defined structure of goals meaning that users are able to navigate to any part of the system at any time; this means they have the freedom to delete any data or even entire queries.
Consistency and standards	Comments arose around the icons Access uses to represent different types of queries, Jason advised that these should give a better reflection and made comments about how to use colour effectively (for example when a user is working through a task a potential menu on the top could be highlight green for complete and orange for partially complete, the final task cannot be completed until all are green).
Error prevention	Erroneous tasks should not be possible, for example running a query before its prerequisite should not be possible or exporting cannot be done until all other steps have been completed.
Recognition rather than recall	
Flexibility and efficiency of use	During the interview Jason discussed how the help was good in some parts of the system, i.e. before running a query it displays the following prompt:  This is useful as an accelerator since there is additional help available for users that need it.
Aesthetic and minimalist design	At numerous locations during the system message prompts contain information which is irrelevant or rarely needed. Messages should be relevant and only shown when required.
Help users recognise, diagnose, and recover from errors	At start-up of the system the following prompt is displayed:

	 It is unclear to the user what this is and what the consequence is when 'yes' or 'no' is clicked. Jason checked the additional help was but was still unsure so clicked on yes but then was unable to proceed with the task and had to reopen the system.
Help and documentation	The user instructions fail in numerous places, for an unfamiliar user they would not be able to complete the task from these instructions only.

Section 5: OneLilly Brand Ratings – Also shows which positions/divisions belong to which sales team

OneLilly Brand Ratings

Sales Team	COMPASS Target Rating	Product	OneLilly Brand Rating Q2	OneLilly Brand Rating Q3	OneLilly Brand Rating Q4	*EXAMPLE POSITION*	*EXAMPLE DIVISION*
Primary Care	C1, C1M1, M1C1	Cialis	Cia-ED	Cia-ED	**Cia-ED**	*UK-PCARE-011D*	*UK-PCARE1*
	M1, C1M1, M1C1	Cymbalta	Cym-Dep	Cym-Dep	**Cym-Dep**	*UK-PCARE-011I*	*UK-PCARE-CSO1*
	D1, D1S1	Cialis	Cia-ED	Cia-ED	**Cia-ED**	*UK-PCARE-011L*	*UK-PCARE2*
	D1S1	Yentreve	Yen-SUI			*UK-PCARE-011X*	*UK-PCARE3*
						UK-PCARE-011Z	*UK-PCARE-CSO2*
Primary Care HFR	D1	Cialis	Cia-ED	Cia-ED	**Cia-ED**	*UK-PCARE-001E*	*UK-PCARE-HFR*
	S1	Yentreve	Yen-SUI	Yen-SUI	**Yen-SUI**		
ADHD	T1	Strattera	Stra-T1	Stra-T1	**Stra-T1**	*UK-ADHD-011C*	*UK-ADHD*
	T2	Strattera	Stra-T2	Stra-T2	**Stra-T2**		
	T3	Strattera	Stra-T3	Stra-T3	**Stra-T3**		
	T4	Strattera	Stra-T4	Stra-T4	**Stra-T4**		
LOGH	F1	Forsteo	For-F1	For-F1	**For-F1**	*UK-LOGH-011T*	*UK-LOGH*
	F2	Forsteo	For-F2	For-F2	**For-F2**		
	H1	Humatrope	HGH-H1	HGH-H1	**HGH-H1**		
LPG-Schiz	S1	Zyprexa	Zyp-Sch	Zyp-Sch	**Zyp-Sch**	*UK-LPG-011P*	*UK-LPG-SCHIZ*
	S2	Zyprexa	Zyp-Sch2	Cym-Dep	**Cym-Dep**		
LPG-Bip	B1	Zyprexa	Zyp-Bip	Zyp-Bip	**Zyp-Bip**	*UK-LPG-011B*	*UK-LPG-BP*
	B2	Zyprexa	Zyp-Bip2	Cym-Dep	**Cym-Dep**		
LPG-Mood	D1	Cymbalta	Cym-Dep	Cym-Dep	**Cym-Dep**	*UK-LPG-011N*	*UK-LPG-MOOD*
	D2	Cymbalta	Cym-Dep2	Zyp-Sch	**Zyp-Sch**		
LPG-RSP	R1	Cymbalta	Cym-Dep	Cym-Dep	**Cym-Dep**	*UK-LPG-011R*	*UK-LPG-RSP*
		Zyprexa	Zyp-Sch	Zyp-Sch	**Zyp-Sch**		
		Zyprexa	Zyp-Bip	Zyp-Bip	**Zyp-Bip**		
LPG-HDO					**TBD**	*UK-LPG-011H*	*UK-LPG-HDO1*
						UK-LPG-011J	*UK-LPG-HDO2*
Oncology	O1	Gemzar	Gem-BL	Gem-BL	**Gem-BL**	*UK-ONCO-011G*	*UK-ONCOLOGY*
		Gemzar	Gem-L	Gem-L	**Gem-L**		
	O2	Gemzar	Gem-P	Gem-P	**Gem-P**		
		Gemzar	Gem-B	Gem-B	**Gem-B**		
	O3	Gemzar	Alm-M	Alm-M	**Alm-M**		
		Gemzar	Alm-L	Alm-L	**Alm-L**		
Diabetes	T1	Humalog	HLOG-T1	HLOG-T2	**HLOG-T2**	*UK-DIAB-011M*	*UK-DIABETES1*
		Humalog Mix25	HMIX25-T1	HMIX25-T2	**HMIX25-T2**	*UK-DIAB-011W*	*UK-DIABETES2*
		Humalog Mix50	HMIX50-T1	HMIX50-T2	**HMIX50-T2**	*UK-DIAB-011S*	*UK-DIABETES3*
		Byetta	BTA-T1	BTA-T2	**BTA-T2**		
	T2	Humalog	HLOG-T2	HLOG-T3	**HLOG-T3**		
		Humalog Mix25	HMIX25-T2	HMIX25-T3	**HMIX25-T3**		
		Humalog Mix50	HMIX50-T2	HMIX50-T3	**HMIX50-T3**		
		Byetta	BTA-T2	BTA-T3	**BTA-T3**		
	T3	Humalog	HLOG-T3	HLOG-T4	**HLOG-T4**		
		Humalog Mix25	HMIX25-T3	HMIX25-T4	**HMIX25-T4**		
		Humalog Mix50	HMIX50-T3	HMIX50-T4	**HMIX50-T4**		
		Byetta	BTA-T3	BTA-T4	**BTA-T4**		

5. Data file preparation

5.1 General file specification

The file is an ASCII delimited one with

Field separator = "|"
End of record Separator = "|="
(plus standard <CR> or/and <LF> character depending on source Operating System. MQ and Informatica will take of conversion if required)

The Objective file will contain 4 record types: OBJT, OBTM, OPRD and OBCF (see section 5.3 for more details about record types). There is no need to sort the record types as the OneLilly Interface will do it in order to process the record types in the correct order (first the Business Plans and Objective Headers, the Objective facts).

The file should be generated with UTF8 unicode character set. The file shouldn't contain any header (3 character header common in UTF-8 files).

Each file per affiliate/Input Format will be transported from Affiliate server to One Lilly Informatica Windows Server through WebSphere MQ with specific routing ID (one per affiliate and Input Format, e.g. one for Japan Product).

5.2 Allowed Operations

The process will handle Insert and Update; it will not handle physical deletion. The name of the objective cannot be updated.
The update operation may perform Logical deletion, changing the objective or business plan status from "Current" to "Expired"

5.3 List of Record Types

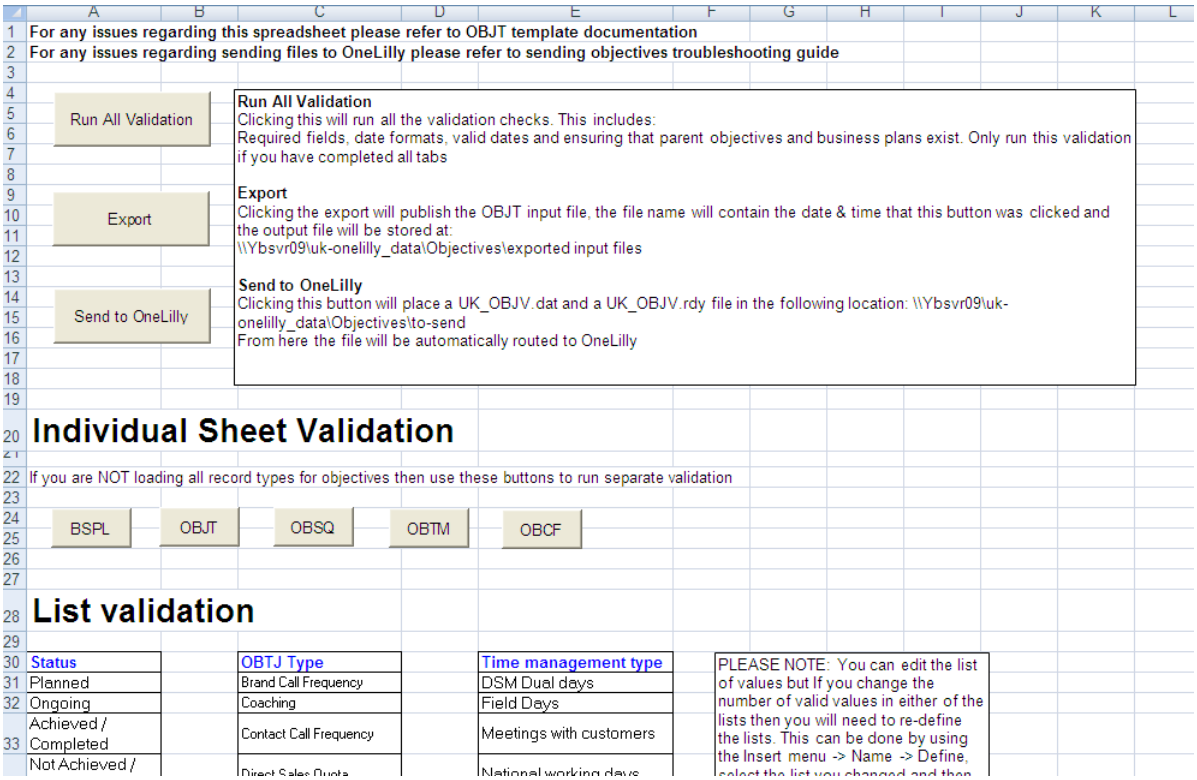
The Objective file contains the following record types:

- OBJT Used for most of the Objective Headers: Sales Quota, Key Account, Key Contact, Expenses, Call Frequency, Coaching…
- OBTM Used for Time Management objective facts.
- OBSQ Used for Sales Quota objective facts.
- OBCF Used for Call Frequency objective facts.
- BSPL Used for Business plan header.
- BPSW Used for Business plan facts (notes).

5.4 Technical Data Rules

Confidential to Eli Lilly and Company

Section 7: Print Screen of template used to combine and export data



For any issues regarding this spreadsheet please refer to OBJT template documentation
For any issues regarding sending files to OneLilly please refer to sending objectives troubleshooting guide

Run All Validation

Export

Send to OneLilly

Run All Validation
Clicking this will run all the validation checks. This includes:
Required fields, date formats, valid dates and ensuring that parent objectives and business plans exist. Only run this validation if you have completed all tabs

Export
Clicking the export will publish the OBJT input file, the file name will contain the date & time that this button was clicked and the output file will be stored at:
\\Ybsvr09\uk-onelilly_data\Objectives\exported input files

Send to OneLilly
Clicking this button will place a UK_OBJV.dat and a UK_OBJV.rdy file in the following location: \\Ybsvr09\uk-onelilly_data\Objectives\to-send
From here the file will be automatically routed to OneLilly

Individual Sheet Validation

If you are NOT loading all record types for objectives then use these buttons to run separate validation

BSPL | OBJT | OBSQ | OBTM | OBCF

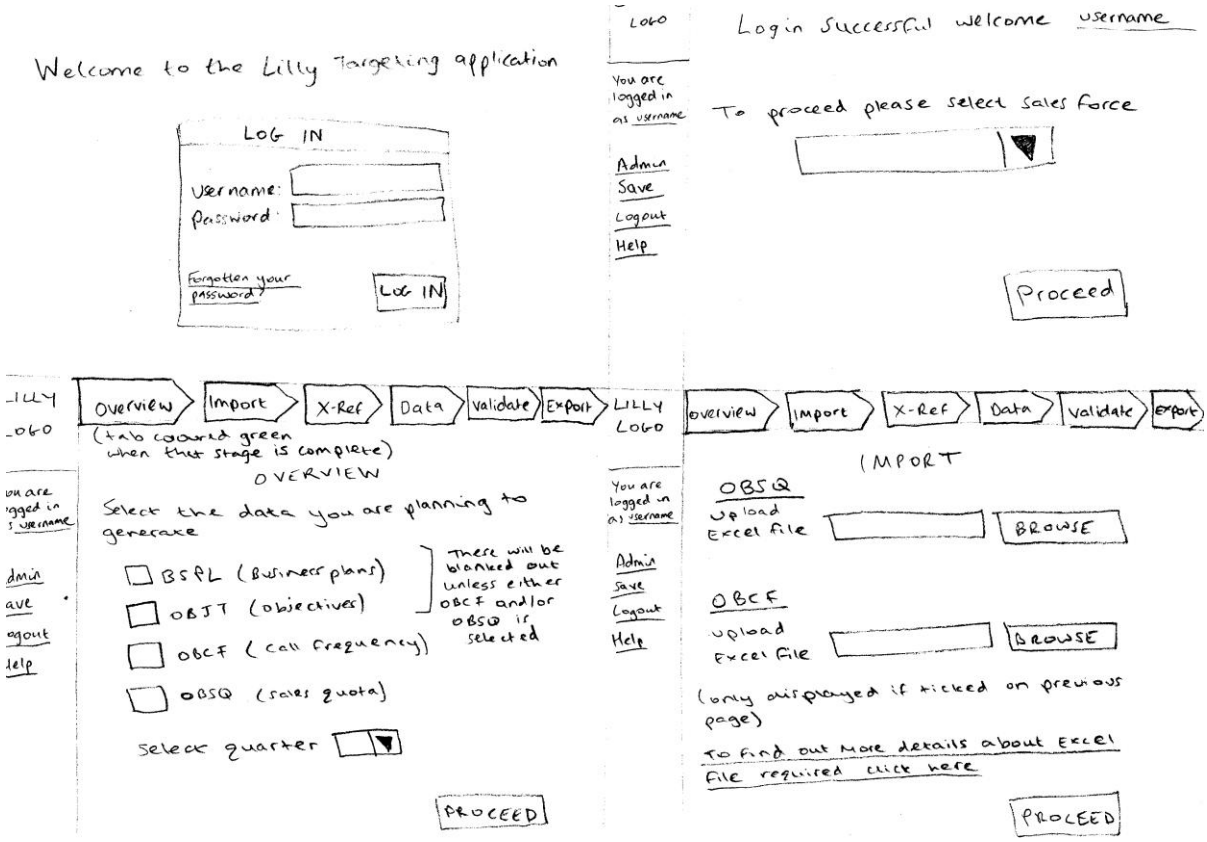
List validation

Status	OBTJ Type	Time management type
Planned	Brand Call Frequency	DSM Dual days
Ongoing	Coaching	Field Days
Achieved / Completed	Contact Call Frequency	Meetings with customers
Not Achieved /	Direct Sales Quota	National working days

PLEASE NOTE: You can edit the list of values but If you change the number of valid values in either of the lists then you will need to re-define the lists. This can be done by using the Insert menu -> Name -> Define, select the list you changed and then

Appendix B: Design Supporting Documentation

Section 1: User Interface Design sketches completed by end-users



SIDE AND TOP NAVIGATION REMAIN THE SAME AS PREVIOUS PAGES

X-REF

Sales reps have selected the following

Please select the objective:

Shows an example where Add was clicked

Position letter	Rating	Objective	Product	Indication	Objective parent
R	A+	Add objective			
R	A	Add objective			
R	B	Add objective			
R	NOT NULL	Add objective			

greyed out or coloured so cannot be edited

Will all be automatically filled in (but editable if required) when the objective has been selected

PROCEED

DATA

Click each link to view and edit the data that has been produced

- BSPL
- OBJT
- OBCF
- OBSQ
- ALL

Example of OBJT

EXPORT TO EXCEL

OBJT

Affiliation code	record type	source system	→
↓			

Clicking col name sorts by this

DELETE select rows you wish to delete

ADD click here to manually enter a new row

EDIT select row you wish to edit

PROCEED

VALIDATE

RUN ALL VALIDATION (same as excel)

or run seperately

BSPL OBJT OBCF OBSQ

GET SAMPLE click here to randomly select number of rows you need to verify

EXPORT TO EXCEL

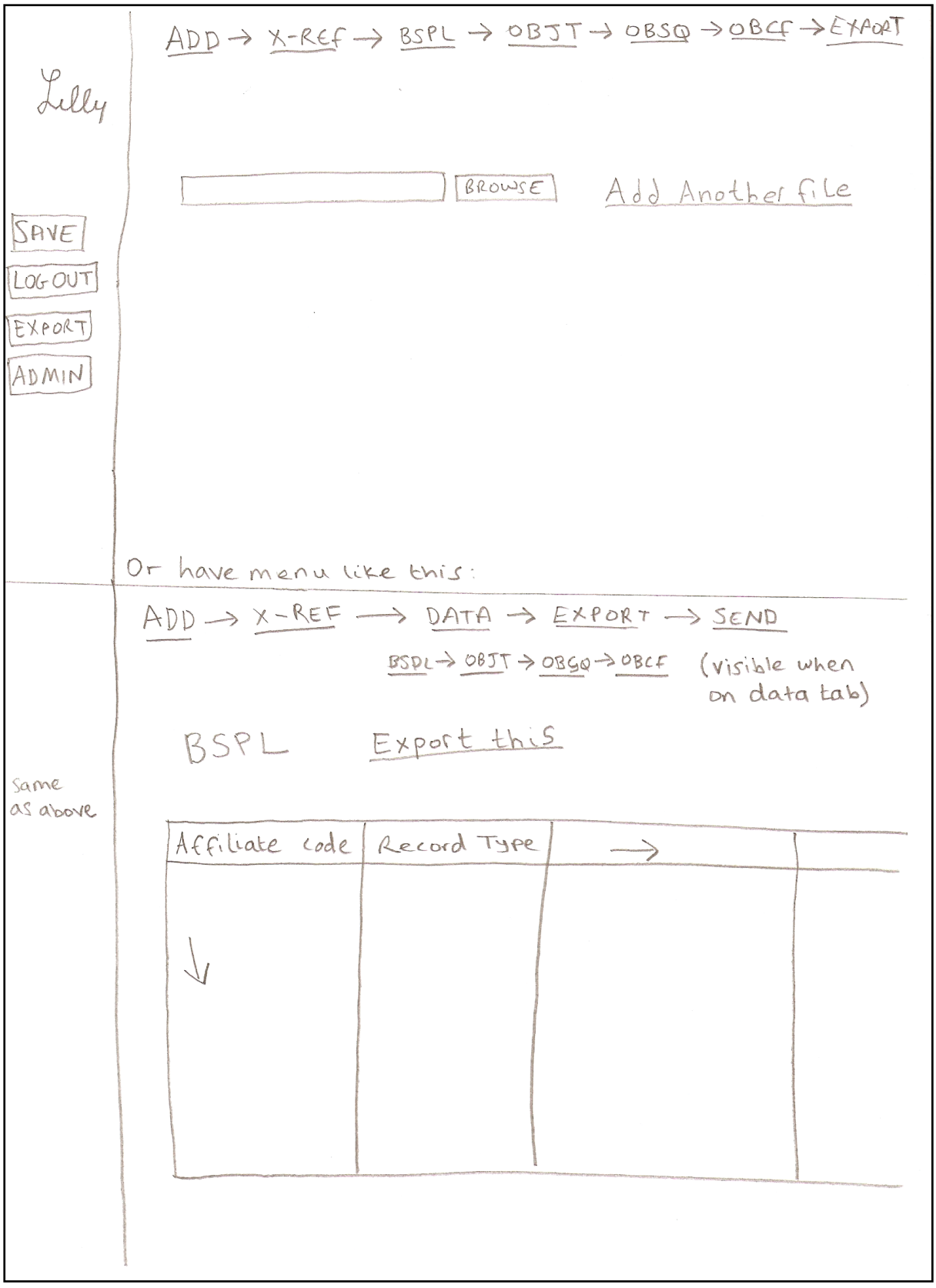
EXPORT

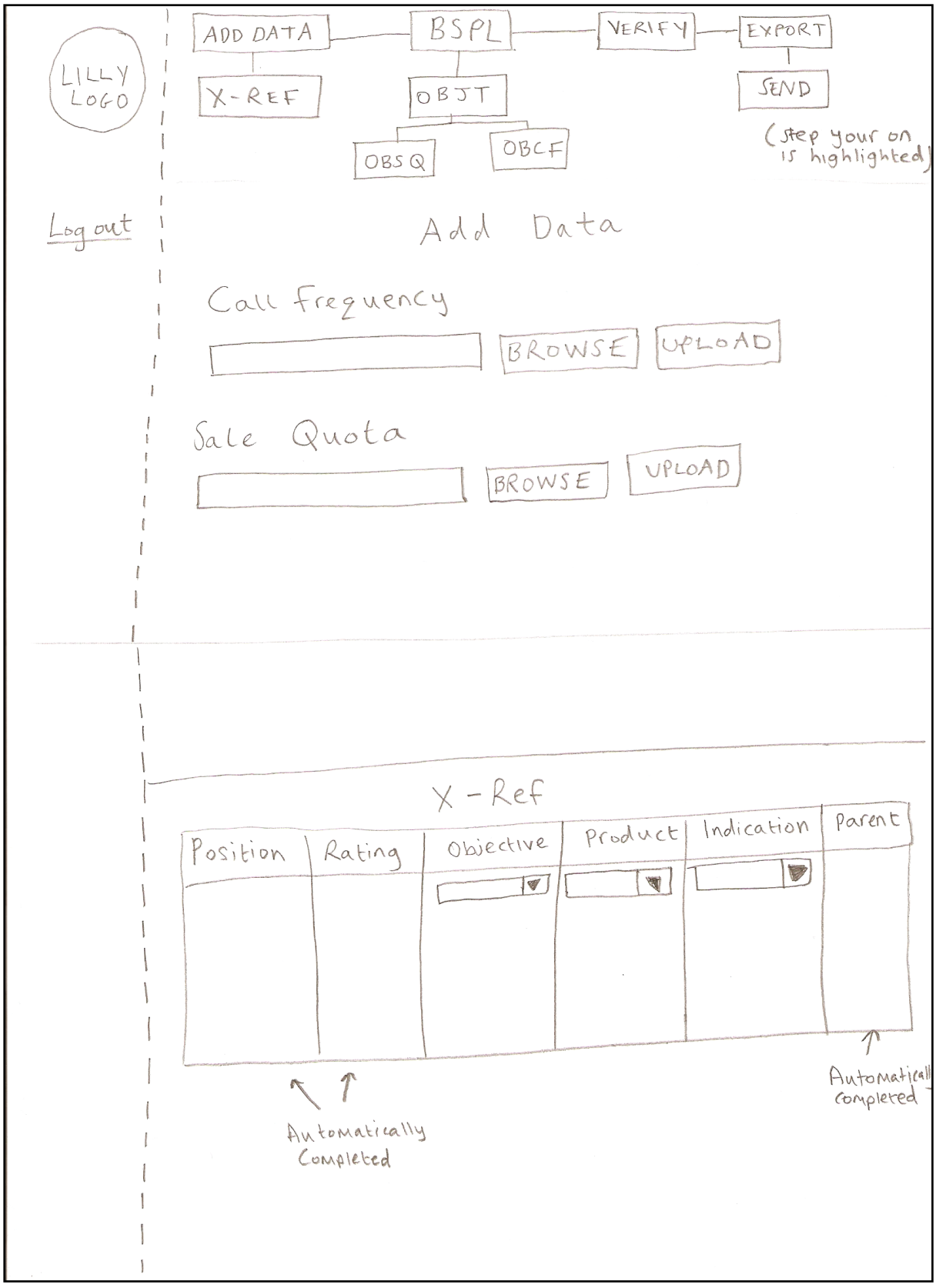
To view final file in Excel before exporting click here

To view completed data in correct format click here

Export completed file

Send to OneLilly


ADD → X-REF → BSPL → OBJT → OBSQ → OBCF → EXPORT
Lilly
BROWSE
Add Another file
SAVE
LOG OUT
EXPORT
ADMIN
Or have menu like this:
ADD → X-REF → DATA → EXPORT → SEND
BSPL → OBJT → OBSQ → OBCF (visible when on data tab)
BSPL
Export this
same as above
Affiliate code
Record Type
→


LILLY LOGO
ADD DATA
BSPL
VERIFY
EXPORT
X-REF
OBJT
SEND
OBSQ
OBCF
(step your on is highlighted)
Log out
Add Data
Call Frequency
BROWSE
UPLOAD
Sale Quota
BROWSE
UPLOAD
X-Ref
Position
Rating
Objective
Product
Indication
Parent
Automatically Completed
Automatically Completed

Lilly

BSPL

	Affiliate code	Record Type	operation	etc .... →
Edit	VK	BSPL	I	

Open in Excel

Lilly

VIEW IN ONELILLY FORMAT

BSPL

OBJT

OBSQ

OBCF

ALL

Export Send Finish

Section 2: Copy of email communications for the CARD activity

Original Email Sent

On 26 March 2008, at 09:18, Samantha Cooper wrote:

Hi Nicola / Carol,

Following on from our phone call here are the instructions for the CARD activity. Thanks again for agreeing to complete this activity in such short notice.

Attached are two files:
1. A JPEG containing a picture of 11 cards (which you will need to print and cut out)
2. An example data set for one sales representative (although slightly shortened to make it more appropriate to complete this task).

What you need to do:
Imagine the cards are now the system and you need to generate OBCF and the corresponding data only for the 192R sales representative.

Simply arrange the cards in the order you would expect/like to see screen whilst you complete the targeting data.

- you may use a card more than once (which you will need to since there is only one card for viewing data but you will have more than one)
- You can also create your own cards if you feel there is something missing

Please either write on the cards (or paper if you prefer) any decisions you made at a particular step e.g. you selected 'OBCF' and 'OBJT' or you decided that editing was 'not required'. I understand that you have limited time but if you could also consider anything that you feel is missing or not right and take any notes on this. Maybe you have a new idea? Or thought of something that is missing?

What Information you need to send back to me:

- The CARD ordering you choose, either take a photograph or record the card numbers
- All notes on the decisions you made
- Any additional thoughts you had whilst completing the task

If there is anything you are unclear about or if you have any questions at all then please feel free to call me. Thanks very much for your help.

Kind Regards,

Sam

Reply email

On 27 March 2008, at 17:18, lindsay_nicola_e@lilly.com wrote:

Hey Sam,

I have added the both mine and Carol's ordering (and decisions) to the bottom of this email. I noticed something that we could be missing (or maybe it just didn't fit on the card?). Card 5 does not have a column to select the call frequency. Not sure how we missed this in original designs but obviously as you know this is just added to the SQL code in our current system but I'm guessing it would now go with the cross reference? What do you think?

Also we thought there should be an additional card between 3 and 4, if I remember rightly in our last discussions we said there would be validation during import so would we need to view feedback on the import? We added a card for "View import results and decide whether to terminate and restart or continue" hope that's ok!

Apart from that we are happy with the general design of each screen :-) Give me a call if you need anything else and see you shortly,

Nicola

Ordering & decisions
Me:
1: Decide I need OBJT & OBCF
2: Presuming I am completing this for the current time period I would select "Q2" and "2008" and tick the boxes for "OBJT" and "OBCF"
3: Guessing following on from our previous discussions that the upload box for OBSQ would not be present since I did not select this.
3.5 (our new card!): I will decide to continue
4: 2 selected ratings from sales force R. I will have A which will map to the objective "Zyp-Sch" and B which will map to the objective "Zyp-Bip"
5: I'm guessing that N is only there as an example? Since there are no N reps in the data you gave us? I will ignore that value! I would select the "Zyp-Sch" from the drop down box (again as we have previously discussed I am guessing that the remaining fields will be automatically filled in?) I would like click on "Add objective" and add "Zyp-Bip" to that R as well
6: I would chose OBJT first
7: Looking at my results
8: No editing required
Go back to card 6: Now choose OBCF
7: Looking at my results
8: No editing required
10: Open my file (I would save it and open it from there)
11: Export file!

Carol:
1: OBJT & OBCF
2: I would select "Q3" and "2008" and tick the boxes for "OBJT" and "OBCF"
3: Add my file
New card to view upload feedback: Decide to continue
4: A -> "Zyp-Sch" and B -> "Zyp-Bip"
5: Select the "Zyp-Sch" from the drop down box (will the rest the fields be automatically added?) I would then click on "Add objective" and add "Zyp-Bip" to that R as well
6: I would chose OBCF first
7: Look at my results
8: No editing required
Go back to card 6: Now choose OBJT
7: Look at my results
8: No editing required

10: Open my file
11: Export file

Nicola LINDSAY BSc (Hons)
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(Embedded image moved to file: pic22532.gif)

Section 3: Email communications for selected ratings validation requirements

On 07 March 2008, at 13:18, lindsay_nicola_e@lilly.com wrote:

The checks required on imported selected ratings are:

The position, division and contact integration ID fields all have to be less than 15 characters (and cannot be empty)

The selected ratings that are allowed are: A, A+, B, B+, C, C+, Non-Target

Appendix C: Implementation Supporting Documentation

Section 1: Email feedback during implementation

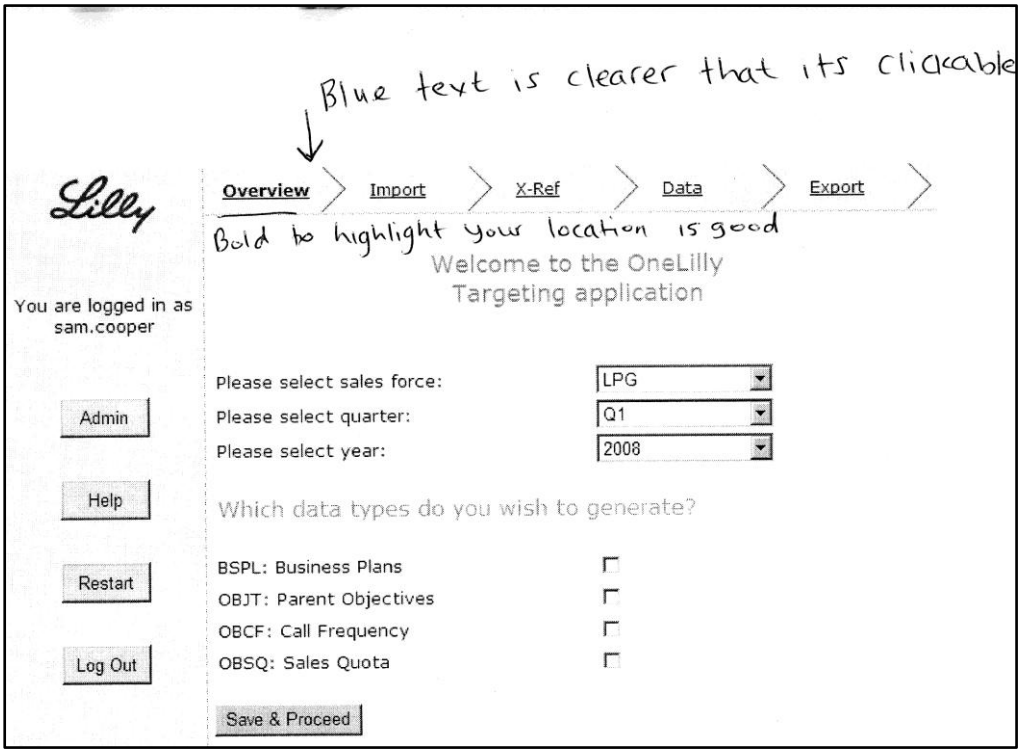
On 17 March 2008, at 13:18, goddard_card@lilly.com wrote:

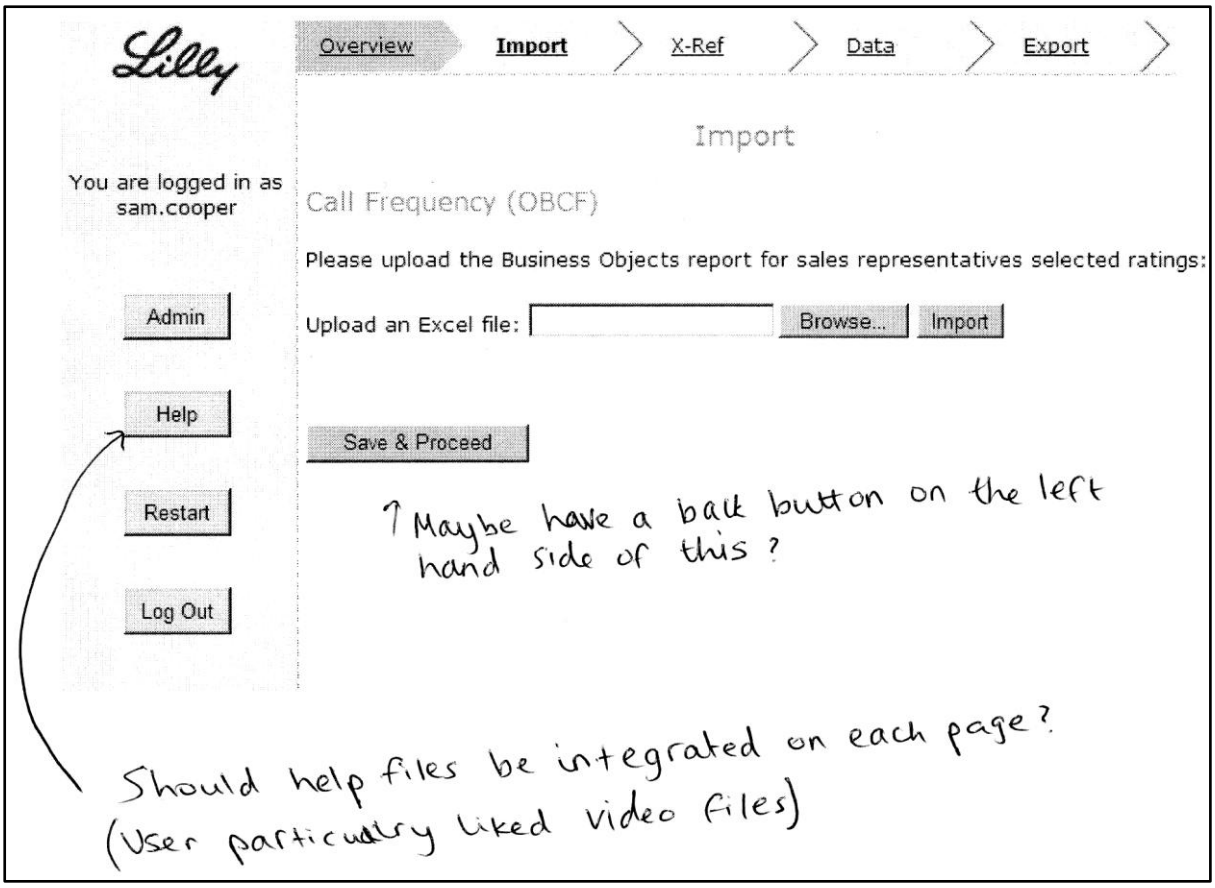
Hi Sam,

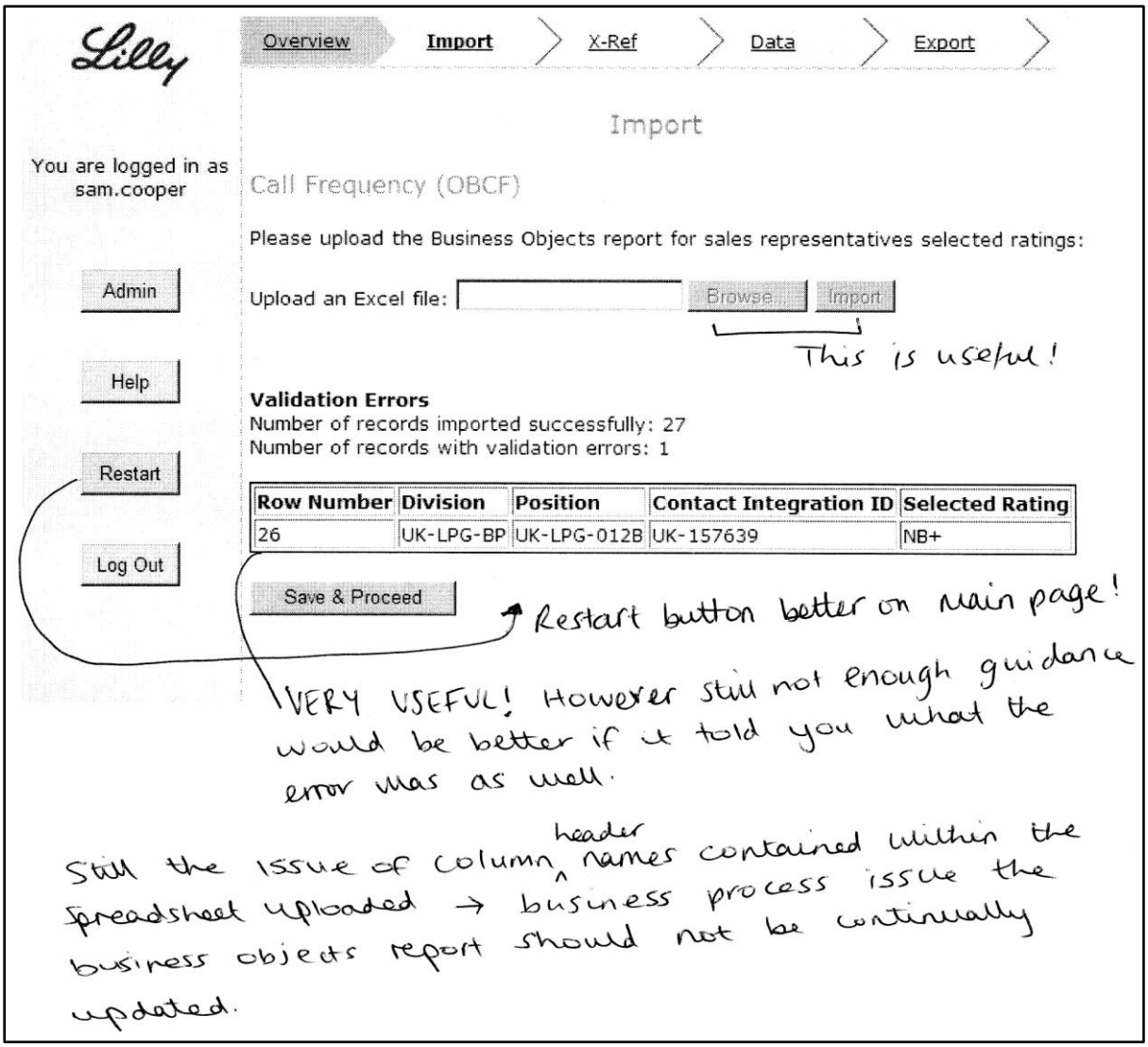
I looked over what you have done so far and it's looking great! Here are just a few comments:

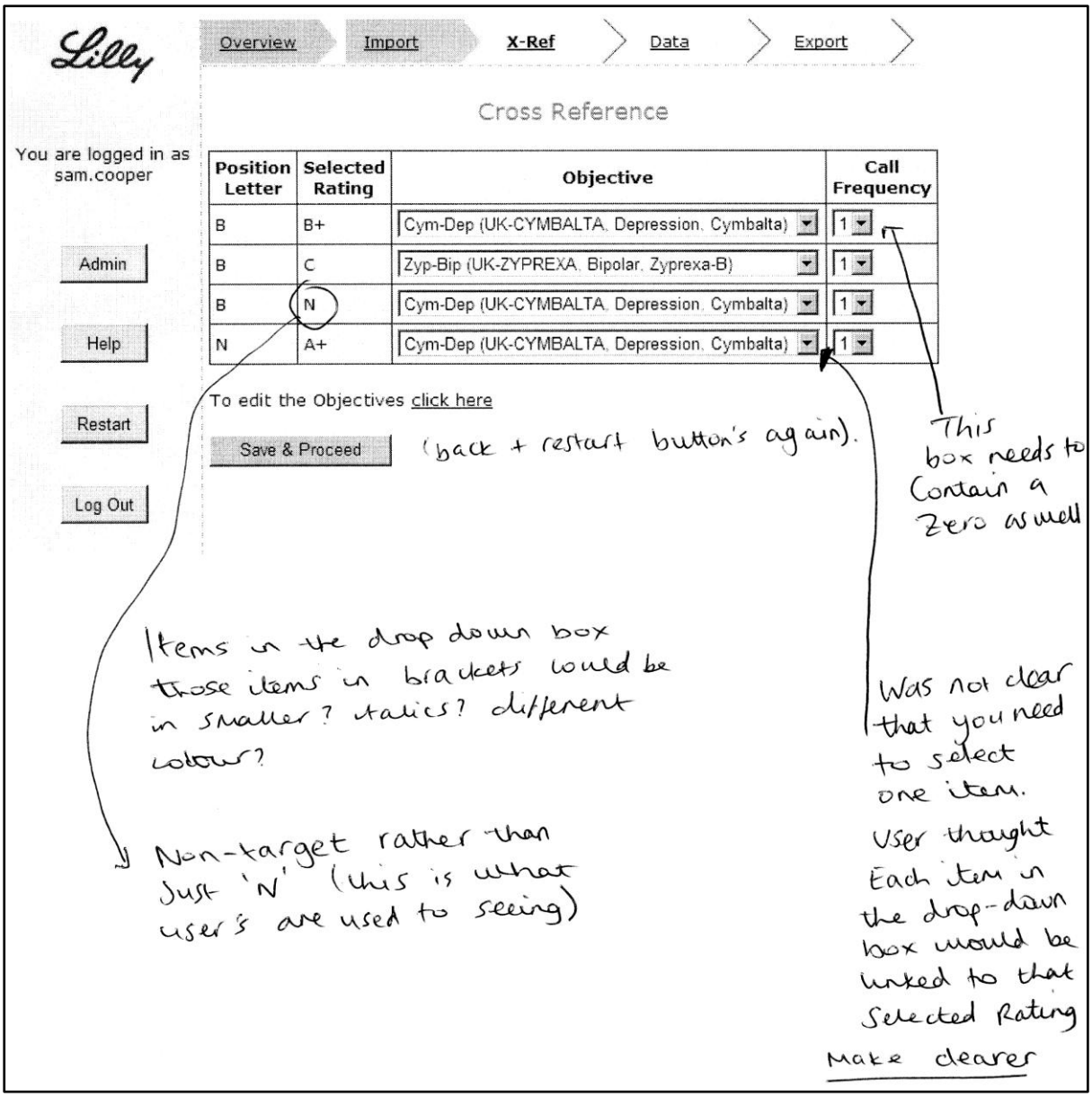
- At the moment even when I don't have a file in the upload box I can still press upload
- When I did upload the file it said 23 rows were imported but there was only 22
- When your viewing data the 'data' link in the navigation is not bold
- None of the export functionality appears to be working yet? But I guess you not finished yet?

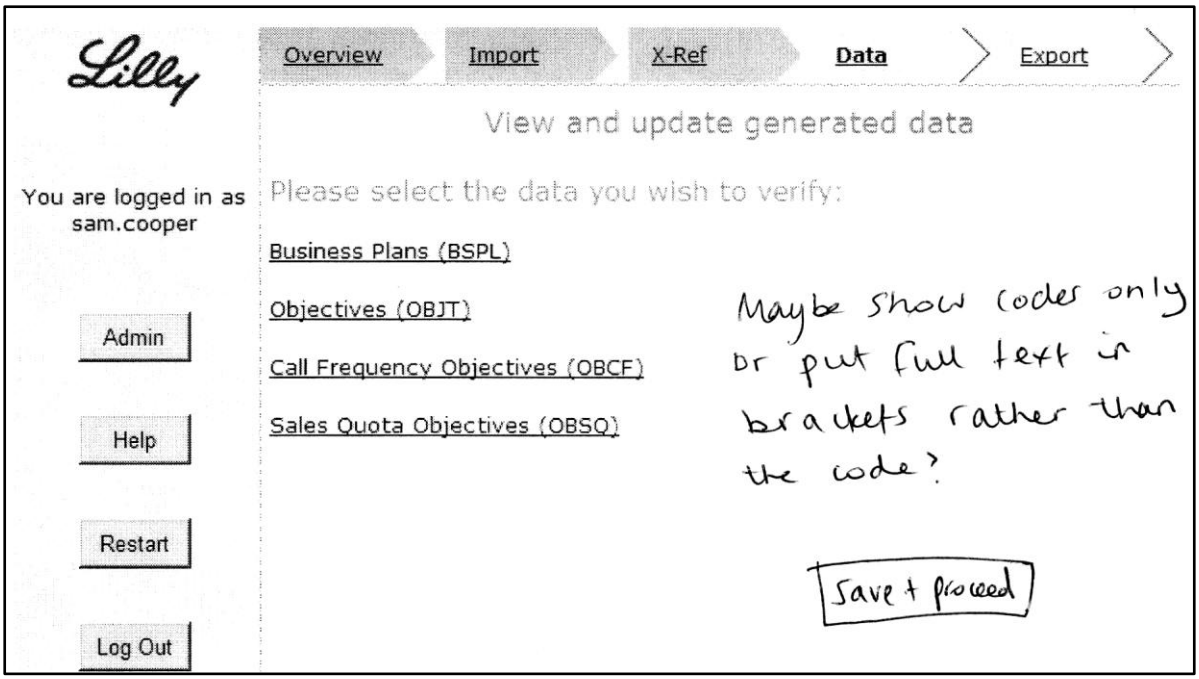
Section 2: Feedback via annotated print screens during implementation

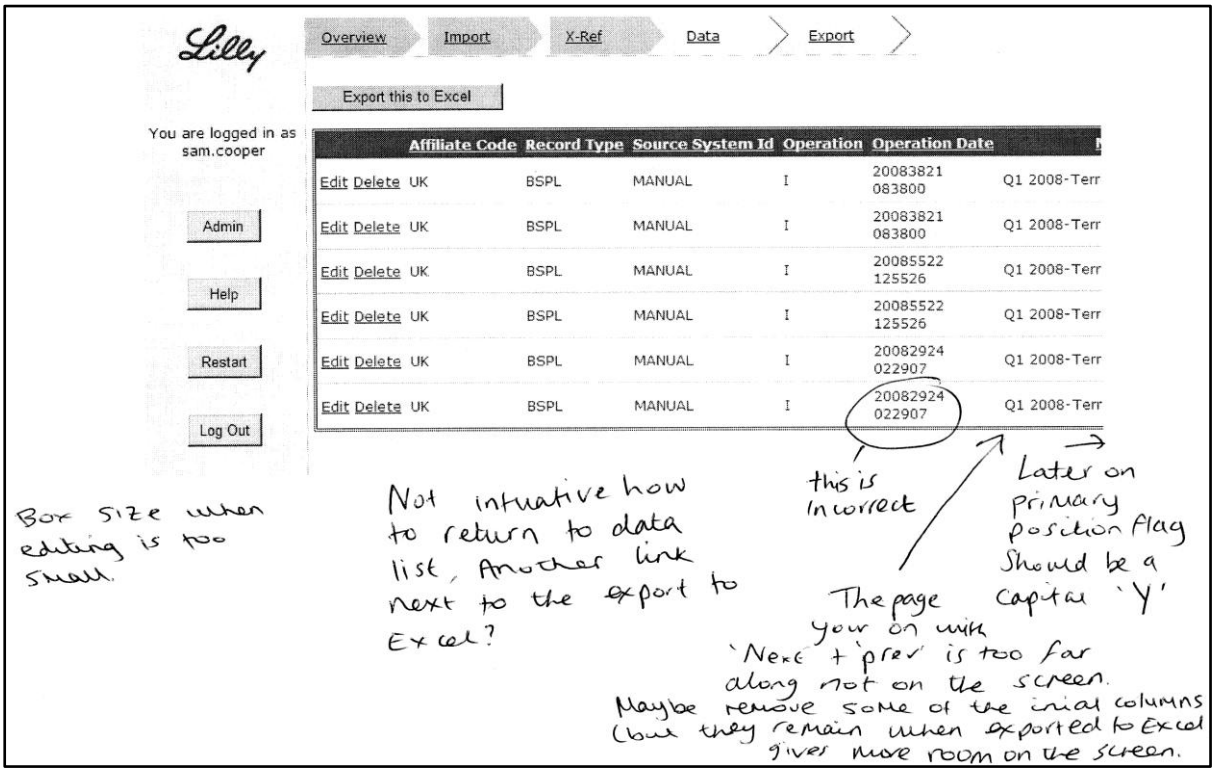


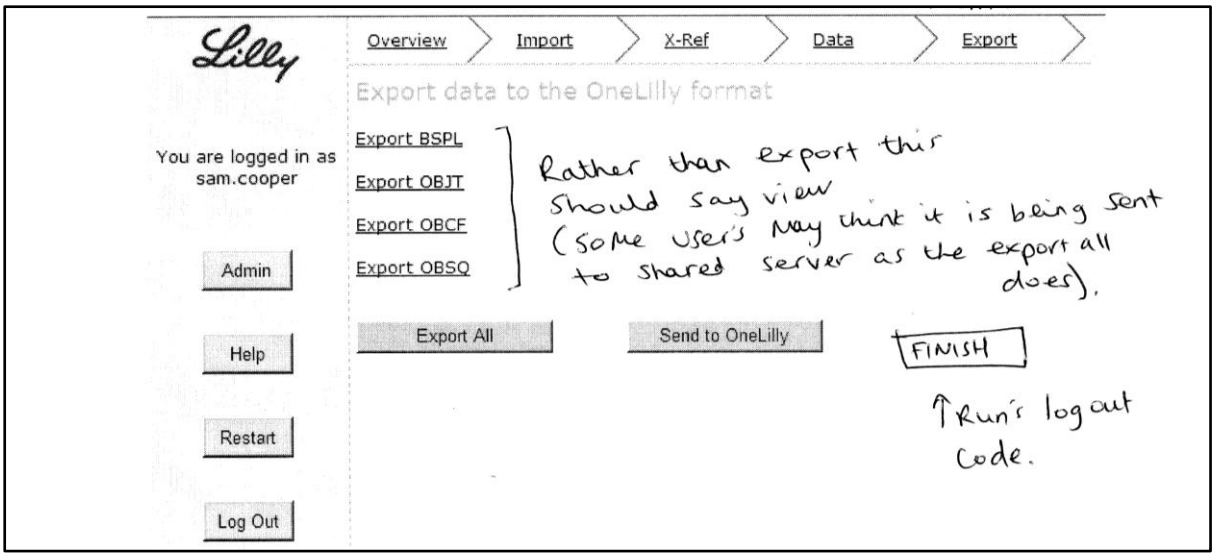

Lilly
Overview
Import
X-Ref
Data
Export
Import
You are logged in as sam.cooper
Call Frequency (OBCF)
Please upload the Business Objects report for sales representatives selected ratings:
Admin
Upload an Excel file:
Browse...
Import
Help
Save & Proceed
Restart
Log Out
↑ Maybe have a back button on the left hand side of this?
Should help files be integrated on each page?
(User particularly liked video files)


Lilly
Overview
Import
X-Ref
Data
Export
Import
You are logged in as sam.cooper
Call Frequency (OBCF)
Please upload the Business Objects report for sales representatives selected ratings:
Admin
Upload an Excel file:
Browse...
Import
This is useful!
Help
Validation Errors
Number of records imported successfully: 27
Number of records with validation errors: 1
Restart
Row Number | Division | Position | Contact Integration ID | Selected Rating
26 | UK-LPG-BP | UK-LPG-012B | UK-157639 | NB+
Log Out
Save & Proceed
Restart button better on main page!
VERY USEFUL! However still not enough guidance would be better if it told you what the error was as well.
Still the issue of column header names contained within the spreadsheet uploaded → business process issue the business objects report should not be continually updated.


Lilly
Overview
Import
X-Ref
Data
Export
Cross Reference
You are logged in as sam.cooper
Admin
Help
Restart
Log Out
Position Letter
Selected Rating
Objective
Call Frequency
B
B+
Cym-Dep (UK-CYMBALTA, Depression, Cymbalta)
1
B
C
Zyp-Bip (UK-ZYPREXA, Bipolar, Zyprexa-B)
1
B
N
Cym-Dep (UK-CYMBALTA, Depression, Cymbalta)
1
N
A+
Cym-Dep (UK-CYMBALTA, Depression, Cymbalta)
1
To edit the Objectives click here
Save & Proceed
(back + restart button's again).
This box needs to Contain a Zero as well
Items in the drop down box those items in brackets would be in smaller? italics? different colour?
Non-target rather than just 'N' (this is what users are used to seeing)
Was not clear that you need to select one item.
User thought Each item in the drop-down box would be linked to that Selected Rating
Make clearer


Lilly
Overview
Import
X-Ref
Data
Export
View and update generated data
You are logged in as sam.cooper
Please select the data you wish to verify:
Business Plans (BSPL)
Objectives (OBJT)
Call Frequency Objectives (OBCF)
Sales Quota Objectives (OBSQ)
Admin
Help
Restart
Log Out
Maybe show codes only or put full text in brackets rather than the code?
Save + proceed


Lilly
Overview
Import
X-Ref
Data
Export
Export this to Excel
You are logged in as sam.cooper
Admin
Help
Restart
Log Out
Affiliate Code
Record Type
Source System Id
Operation
Operation Date
Edit Delete UK BSPL MANUAL I 20083821 083800 Q1 2008-Terr
Edit Delete UK BSPL MANUAL I 20083821 083800 Q1 2008-Terr
Edit Delete UK BSPL MANUAL I 20085522 125526 Q1 2008-Terr
Edit Delete UK BSPL MANUAL I 20085522 125526 Q1 2008-Terr
Edit Delete UK BSPL MANUAL I 20082924 022907 Q1 2008-Terr
Edit Delete UK BSPL MANUAL I 20082924 022907 Q1 2008-Terr
Box size when editing is too small.
Not intuative how to return to data list, Another link next to the export to Excel?
this is incorrect
Later on primary position flag should be a capital 'Y'
The page you on with 'Next' + 'prev' is too far along not on the screen.
Maybe remove some of the inial columns (but they remain when exported to Excel gives more room on the screen.



Section 3: Draft Test Plan

This is the test plan that users were provided with during and at the end of implementation phase

Step	Task	Test data	Expected Result
1	Complete overview	Select 2009 Q1 Choose to generate BSPL, OBJT & OBCF Click Save & Proceed	Successfully selected Successfully selected When click move to Import screen
2	Import	Click Browse & locate test data Click upload Click Save & Proceed	On clicking browse a file open box will successfully load A message box will be displayed to confirm that the user is happy to progress with upload. Upload results then displayed including number of records both successfully and unsuccessfully imported.
3	Complete cross-reference	Go to the administration screen and update the "Zyp-Bip" to be "Zyp-Bip2" Select an Objective of "Zyp-Bip" and call frequency of 2 for each item	When update is clicked it successfully saves and then displays new value within the drop-down box Selected values successfully selected
4	View/edit data	View each data type Edit one row of data	Successfully navigated to the correct data set Successfully edit and

		within each Delete one row of data within each	updated a row Successfully deleted a row
5	Export	Export the final data file	Successfully open a dialog box prompting user to save or open file.

Appendix D: Evaluation Supporting Documentation

Section 1: Participant experiment instructions

OneLilly Targeting applications comparison experiment

Thank you for taking the time to complete this experiment – if you have any questions throughout then please don't hesitate to stop and ask.

Instructions:
You will be asked to carry out a series of tasks within both the existing and the new OneLilly targeting application. Please note that the experiment will be recorded on a Dictaphone, these recordings will only be available to me and will be used for analysis purposes. Although this will have no impact on how you complete the task the measurements that will be taken include number of clicks, time taken and number of errors made.

Tasks to be completed within BOTH applications:

Section 1
Generate targeting data for all sales reps within the LPG sales force. The data required is call frequency and their parent objectives. It will be for quarter 1 of 2009. This is split into 6 phases

1. Overview/prepare tool
2. Import
3. Updating cross-reference
4. Verify generated data
5. Exporting to the OneLilly format
6. Sending to be loaded

Section 2:
This task is split into a number of short tasks to test the usability of the website. For this task, data will be already be added to the application.

1. Navigate to the cross reference table
2. Navigate to the call frequency data
3. Update the Cross Reference table (and subsequently a new data set) to change positions ending in N with a selected rating of 'A+' to have an objective of 'Zyp-Sch'
4. Within the objectives data update the call frequency of the first record from '1' to '2'.

Section 2: Participant Questionnaire responses

P1

OneLilly Targeting – Questionnaire

Thank you for taking the time to participate in the OneLilly targeting application comparison experiment; if you could please reflect upon the tasks you were asked to do by completing this questionnaire.

On a scale of 1-5 with 1 being strongly disagree and 5 being strongly agree please rank the following for both the existing and the new system:

1. I found it easy to complete the first task
Access solution: 3 New application: 4

2. I found it easy to complete the second task
Access Solution: 3 New application: 5

3. I found it easy to locate the call frequency data 5
Access solution: 4 New application:

4. I didn't need to rely on a user manual or help functions
Access solution: 3 New application: 4

5. I find the system easy to navigate through
Access solution: 2 New application: ~~4~~ 5

6. I found it easy to update the cross-reference table and subsequently the data set
Access solution: 2 New application: ~~3~~ 4

7. I found it easy to edit the data produced
Access solution: 1 New application: 5

Please provide all your general comments on the task or new interface:
All comments were provided via telephone conversation

P2

OneLilly Targeting – Questionnaire

Thank you for taking the time to participate in the OneLilly targeting application comparison experiment; if you could please reflect upon the tasks you were asked to do by completing this questionnaire.

On a scale of 1-5 with 1 being strongly disagree and 5 being strongly agree please rank the following for both the existing and the new system:

1. I found it easy to complete the first task
Access solution: 1 New application: 4

2. I found it easy to complete the second task
Access Solution: 1 New application: 4

3. I found it easy to locate the call frequency data
Access solution: 3 New application: 4

4. I didn't need to rely on a user manual or help functions
Access solution: 1 New application: 4

5. I find the system easy to navigate through
Access solution: 2 New application: 5

6. I found it easy to update the cross-reference table and subsequently the data set
Access solution: 1 New application: 5

7. I found it easy to edit the data produced
Access solution: 2 New application: 5

Please provide all your general comments on the task or new interface:

P3

OneLilly Targeting – Questionnaire

Thank you for taking the time to participate in the OneLilly targeting application comparison experiment; if you could please reflect upon the tasks you were asked to do by completing this questionnaire.

On a scale of 1-5 with 1 being strongly disagree and 5 being strongly agree please rank the following for both the existing and the new system:

1. I found it easy to complete the first task
Access solution: 2 New application: 5

2. I found it easy to complete the second task
Access Solution: 3 New application: 5

3. I found it easy to locate the call frequency data
Access solution: 4 New application: 5

4. I didn't need to rely on a user manual or help functions
Access solution: 3 New application: 5

5. I find the system easy to navigate through
Access solution: 1 New application: 5

6. I found it easy to update the cross-reference table and subsequently the data set
Access solution: 3 New application: 4

7. I found it easy to edit the data produced
Access solution: 1 New application: 5

Please provide all your general comments on the task or new interface:

4

OneLilly Targeting – Questionnaire

Thank you for taking the time to participate in the OneLilly targeting application comparison experiment; if you could please reflect upon the tasks you were asked to do by completing this questionnaire.

On a scale of 1-5 with 1 being strongly disagree and 5 being strongly agree please rank the following for both the existing and the new system:

1. I found it easy to complete the first task
Access solution: 1 New application: 5

2. I found it easy to complete the second task
Access Solution: 1 New application: 5

3. I found it easy to locate the call frequency data
Access solution: 2 New application: 5

4. I didn't need to rely on a user manual or help functions
Access solution: 1 New application: 4

5. I find the system easy to navigate through
Access solution: 1 New application: 5

6. I found it easy to update the cross-reference table and subsequently the data set
Access solution: 1 New application: 4

7. I found it easy to edit the data produced
Access solution: 1 New application: 5

Please provide all your general comments on the task or new interface:

Section 3: Telephone conversation notes (the day after experiment)
Participant 1 notable comments
No technical knowledge required:
"I don't need to understand the fact that a query is being ran, all I need to do is click to view my data"
"I feel a lot more comfortable using this system, I am always worried that I am going to do something wrong within the existing system"
With participant 2 the main discussion focused on the cross-reference table:
"This table confused me at first" The user went onto discuss how she thought everything in the drop-down box was being assigned to that objective, her comment was ""I am just used to manually entering everything, so at first a drop-down box just confused me". She noted how

now that she is aware of the correct process it is an improvement over the existing since no free-text entry.

Participant 3 discussed the interface. Her comments were that “I think a blue colouring would be better, it would match hyperlinks as well”.

Appendix E: Code (Main Classes Only)

Importing Data – Two main classes are: SelectedRatingsImporter.cs

```
using System;
using System.Collections.Generic;
using System.Data;
using System.Data.Common;
using System.Data.SqlClient;

namespace ExcelImporters
{
    public class SelectedRatingsImporter
    {
        public static SelectedRatingsImportResults
ImportSelectedRatingsDataFromFileToDatabaseConnection(string fileName, string
databaseConnectionString)
        {
            SelectedRatingsImportResults results = new SelectedRatingsImportResults();
            string excelConnectionString =
String.Format("Provider=Microsoft.Jet.OLEDB.4.0;Data Source={0};Extended Properties=\"Excel
8.0;HDR=YES;\"", fileName);

            DbProviderFactory factory = DbProviderFactories.GetFactory("System.Data.OleDb");

            List<EISelectedRating> okToImport = new List<EISelectedRating>();
            List<KeyValuePair<int, EISelectedRating>> problems = new List<KeyValuePair<int,
EISelectedRating>>();

            int currentRow = 1;

            using (DbConnection connection = factory.CreateConnection())
            {
                connection.ConnectionString = excelConnectionString;

                using (DbCommand command = connection.CreateCommand())
                {
                    // Main$ comes from the name of the worksheet
                    command.CommandText = "SELECT [Division], [Position], [Con Integration
ID], [My Selected Rating] FROM [Main$]";

                    try
                    {
                        connection.Open();
                    } catch (Exception)
                    {
                        //This is if the file cannot be opened
                        throw new CannotOpenExcelFileException();
                    }

                    try {
                        //when you got to the end of reading  - close connection
                        using (DbDataReader dr =
command.ExecuteReader(CommandBehavior.CloseConnection))
```

```
                        {
                            while (dr.Read())
                            {
                                currentRow++;
                                EISelectedRating r = new EISelectedRating();
                                r.Division = dr["Division"].ToString();
                                r.Position = dr["Position"].ToString();
                                r.ConIntegrationID = dr["Con Integration ID"].ToString();
                                if (dr["My Selected Rating"].ToString().Equals("Non-Target"))
{
                                    r.SelectedRating = "N";
                                } else {
                                    r.SelectedRating = dr["My Selected Rating"].ToString();
                                }

                                string s1 = dr["Position"].ToString();
                                int length = s1.Length;
                                //take the last letter of position
                                r.PositionLetter = s1[(length - 1)];

                                if (SelectedRatingsImporter.RatingOKForImport(r))
                                {
                                    okToImport.Add(r);
                                }
                                else
                                {
                                    problems.Add(new KeyValuePair<int,
EISelectedRating>(currentRow, r));
                                }
                            }
                        }
                    }
                    catch (Exception)
                    {
                        //This is if reading the data fails
                        throw new ExcelFileInWrongFormatException();
                    }
                }
            }

            results.NumberOfRatingsSuccessfullyValidated = okToImport.Count;
            results.RatingsWithValidationErrors = problems;

            int importCount = 0;

            ExcelImportersDataContext db = new ExcelImportersDataContext();

            foreach (EISelectedRating r in okToImport)
            {
                db.EISelectedRatings.InsertOnSubmit(r);
            }

            db.SubmitChanges();
            results.NumberOfRatingsSuccessfullyImported = okToImport.Count;

            return results;
        }


        private static bool RatingOKForImport(EISelectedRating r)
        {
            if (string.IsNullOrEmpty(r.Division) || r.Division.Length > 15)
                return false;
            if (string.IsNullOrEmpty(r.Position) || r.Position.Length > 15)
                return false;
            if (string.IsNullOrEmpty(r.ConIntegrationID) || r.ConIntegrationID.Length > 15)
                return false;
            if (string.IsNullOrEmpty(r.SelectedRating))
                return false;
            switch (r.SelectedRating)
            {
                case "A":
```

```
                    return true;
                case "A+":
                    return true;
                case "B":
                    return true;
                case "B+":
                    return true;
                case "C":
                    return true;
                case "C+":
                    return true;
                case "N":
                    return true;
                default:
                    return false;
            }
        }
    }
}
```

SelectedRatingsImportResults.cs

```
using System.Collections.Generic;

namespace ExcelImporters
{
    public class SelectedRatingsImportResults
    {
        private List<KeyValuePair<int, EISelectedRating>> _ratingsWithValidationErrors;
        private int _numberOfRatingsSuccessfullyValidated;
        private int _numberOfRatingsSuccessfullyImported;

        public List<KeyValuePair<int, EISelectedRating>> RatingsWithValidationErrors
        {
            get { return _ratingsWithValidationErrors; }
            set { _ratingsWithValidationErrors = value; }
        }

        public int NumberOfRatingsSuccessfullyValidated
        {
            get { return _numberOfRatingsSuccessfullyValidated; }
            set { _numberOfRatingsSuccessfullyValidated = value; }
        }

        public int NumberOfRatingsSuccessfullyImported
        {
            get { return _numberOfRatingsSuccessfullyImported; }
            set { _numberOfRatingsSuccessfullyImported = value; }
        }
    }
}
```

Exporting Data: GridViewExportUtil

```
using System;
using System.Collections.Generic;
using System.Data;
using System.Configuration;
using System.IO;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
using System.Runtime.Serialization.Formatters.Binary;

public class GridViewExportUtil
{
```

```
    public static void Export(string fileName, GridView gridview)
    {
        HttpContext.Current.Response.Clear();
        HttpContext.Current.Response.AddHeader("content-disposition",
string.Format("attachment; filename={0}", fileName));
        HttpContext.Current.Response.ContentType = "application/ms-excel";

        using (StringWriter sw = new StringWriter())
        {
            using (HtmlTextWriter htw = new HtmlTextWriter(sw))
            {
                Table table = new Table();
                table.GridLines = gridview.GridLines;
                if (gridview.HeaderRow != null)
                {
                    GridViewExportUtil.PrepareControlForExport(gridview.HeaderRow);
                    table.Rows.Add(gridview.HeaderRow);
                }
                foreach (GridViewRow row in gridview.Rows)
                {
                    GridViewExportUtil.PrepareControlForExport(row);
                    table.Rows.Add(row);
                }
                if (gridview.FooterRow != null)
                {
                    GridViewExportUtil.PrepareControlForExport(gridview.FooterRow);
                    table.Rows.Add(gridview.FooterRow);
                }
                table.RenderControl(htw);
                HttpContext.Current.Response.Write(sw.ToString());
                HttpContext.Current.Response.End();
            }
        }
    }

    private static void PrepareControlForExport(Control control)
    {
        for (int i = 0; i < control.Controls.Count; i++)
        {
            Control current = control.Controls[i];
            if (current is LinkButton)
            {
                control.Controls.Remove(current);
                control.Controls.AddAt(i,     new     LiteralControl((current     as
LinkButton).Text));
            }
            else if (current is ImageButton)
            {
                control.Controls.Remove(current);
                control.Controls.AddAt(i,     new     LiteralControl((current     as
ImageButton).AlternateText));
            }
            else if (current is HyperLink)
            {
                control.Controls.Remove(current);
                control.Controls.AddAt(i,     new     LiteralControl((current     as
HyperLink).Text));
            }
            else if (current is DropDownList)
            {
                control.Controls.Remove(current);
                control.Controls.AddAt(i,     new     LiteralControl((current     as
DropDownList).SelectedItem.Text));
            }
            else if (current is CheckBox)
            {
                control.Controls.Remove(current);
                control.Controls.AddAt(i,     new     LiteralControl((current     as
CheckBox).Checked ? "True" : "False"));
            }

            if (current.HasControls())
```

```
            {
                GridViewExportUtil.PrepareControlForExport(current);
            }
        }
    }
}
```

Import code-behind file: Import.aspx.cs

```
using System;
using System.Collections;
using System.Configuration;
using System.Data;
using System.Linq;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.HtmlControls;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Xml.Linq;
using ExcelImporters;
using System.Collections.Generic;

public partial class LillyTargeting_Import : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        OBSQPanel.Visible = SharedState.shouldDisplayOBSQ;
        lblFileError.Visible = false;
        lblValidationErrors.Visible = false;
    }
    protected void saveButton_Click(object sender, EventArgs e)
    {
        Response.Redirect("Cross_Reference.aspx");
    }
    protected void cmdUploadCallFrequencyFile_Click(object sender, EventArgs e)
    {
        string filename = "C:\\ToUpload\\CallFrequencyData.xls";
        //TODO: implement checking of the file type here.
        if (fulCallFrequency.HasFile)
        {
            fulCallFrequency.SaveAs(filename);
            SelectedRatingsImportResults                        results                        =
SelectedRatingsImporter.ImportSelectedRatingsDataFromFileToDatabaseConnection(filename,
ConfigurationManager.ConnectionStrings["LillyTargetingConnectionString"].ConnectionString);

            lblCallFrequencyNumberOfValidationErrors.Text                                      =
results.RatingsWithValidationErrors.Count.ToString();
            lblCallFrequencyNumberImportedSuccessfully.Text                                    =
results.NumberOfRatingsSuccessfullyImported.ToString();

            foreach        (KeyValuePair<int,        EISelectedRating>        rowKV        in
results.RatingsWithValidationErrors)
            {
                int rn = rowKV.Key;
                EISelectedRating r = rowKV.Value;

                TableRow row = new TableRow();
                TableCell cell1 = new TableCell();
                cell1.Text = rn.ToString();
                TableCell cell2 = new TableCell();
                cell2.Text = r.Division.ToString();
                TableCell cell3 = new TableCell();
                cell3.Text = r.Position.ToString();
                TableCell cell4 = new TableCell();
                cell4.Text = r.ConIntegrationID.ToString();
                TableCell cell5 = new TableCell();
                cell5.Text = r.SelectedRating.ToString();
```

```
                row.Cells.Add(cell1);
                row.Cells.Add(cell2);
                row.Cells.Add(cell3);
                row.Cells.Add(cell4);
                row.Cells.Add(cell5);

                tblValidationErrors.Rows.Add(row);
            }

            if (results.RatingsWithValidationErrors.Count > 0)
            {
                lblValidationErrors.Visible = true;
                tblValidationErrors.Visible = true;
            }
            else
            {
                tblValidationErrors.Visible = false;
                lblValidationErrors.Visible = false;
            }


            panelCallFrequencyResults.Visible = true;
            cmdUploadCallFrequencyFile.Enabled = false;
            fulCallFrequency.Enabled = false;
        }
        else
        {
            lblFileError.Text = "You must browse for a file";
            lblFileError.Visible = true;

        }
    }
    protected void cmdUploadSalesQuotaData_Click(object sender, EventArgs e)
    {

    }
}
```

Cross Reference code-behind file: Cross_Reference.aspx.cs

```
using System;
using System.Data.Linq;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;

public partial class LillyTargeting_Cross_Reference : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        //to prevent the page from being reset
        if (Page.IsPostBack)
            return;

        TargetingDataContext db = new TargetingDataContext();

        //unique position & letter - items needed in x-ref
        var ratingList = (from sr in db.SelectedRatings
                          orderby sr.PositionLetter
                          select new
                          {
                              sr.PositionLetter,
                              sr.SelectedRatingCode
                          }).Distinct();

        var dropDownItems = (from obm in db.ObjectivesMappings
                             orderby obm.Objective
                             select obm);

        rptUpdate.DataSource = ratingList;
```

```
        rptUpdate.DataBind();

        //for each record returned in ratingList query
        foreach (RepeaterItem i in rptUpdate.Items)
        {
            string posLetter = ((Label)i.FindControl("lblPositionLetter")).Text.Trim();
            string selRating = ((Label)i.FindControl("lblSelectedRating")).Text.Trim();
            string callFreq = ((DropDownList)i.FindControl("callFreq")).Text.Trim();
            CrossReference current = null;
            try
            {
                current   =   db.CrossReferences.SingleOrDefault(p   =>   p.PositionLetter   ==
posLetter && p.UniqueSelectedRating == selRating);
            }
            catch (Exception)
            {
                current = null;
            }
            DropDownList list = (DropDownList)i.FindControl("cmbObjectiveMapping");
            //add items to the objectives drop-down list
            foreach (ObjectivesMapping m in dropDownItems)
            {
                ListItem   l   =   new   ListItem(String.Format("{0}   ({1},   {2},   {3})",
m.Objective.Trim(),    m.Product.Trim(),    m.Indication.Trim(),    m.ObjectiveParent.Trim()),
m.entry_pk.ToString().Trim());
                if (current != null)
                    if (current.ObjectiveMappingID == m.entry_pk)
                        l.Selected = true;

                list.Items.Add(l);
            }
            list.EnableViewState = true;

            //call frequency drop-down list
            DropDownList callFreqList = (DropDownList)i.FindControl("callFreq");

            ListItem item = new ListItem("1");
            ListItem item2 = new ListItem("2");
            ListItem item3 = new ListItem("3");
            ListItem item4 = new ListItem("4");

            callFreqList.Items.Add(item);
            callFreqList.Items.Add(item2);
            callFreqList.Items.Add(item3);
            callFreqList.Items.Add(item4);

            callFreqList.EnableViewState = true;

        }
    }

    protected void cmdSaveCrossReference_Click(object sender, EventArgs e)
    {
        TargetingDataContext db = new TargetingDataContext();

        bool crossReferenceAlreadyHasData = (db.CrossReferences.Count() > 0);

        //to prevent duplicates (as the user is re-saving)
        if (crossReferenceAlreadyHasData)
        {
            db.CrossReferences.DeleteAllOnSubmit<CrossReference>(db.CrossReferences);
        }

        foreach (RepeaterItem i in rptUpdate.Items)
        {
            int test = i.ItemIndex;
            CrossReference r = new CrossReference();

            r.PositionLetter = ((Label)i.FindControl("lblPositionLetter")).Text.Trim();
            r.UniqueSelectedRating = ((Label)i.FindControl("lblSelectedRating")).Text.Trim();
            r.CallFrequency                                                                    =
Int32.Parse(((DropDownList)i.FindControl("callFreq")).Text.Trim());
```

```
            DropDownList                                myDropDownList                                =
((DropDownList)i.FindControl("cmbObjectiveMapping"));
            string s = i.Controls.OfType<DropDownList>().First().SelectedItem.Value;
            r.ObjectiveMappingID                                                                      =
Int32.Parse(((DropDownList)i.FindControl("cmbObjectiveMapping")).SelectedItem.Value.Trim());
            db.CrossReferences.InsertOnSubmit(r);
        }

        db.SubmitChanges();

        //now can update OBCF, OBJT and BSPL tables

        var q1 = from sr in db.SelectedRatings
                    join   r   in   db.CrossReferences   on   sr.SelectedRatingCode   equals
r.UniqueSelectedRating
                    where sr.PositionLetter == r.PositionLetter
                    select sr;

        var q2 = from cr in db.CrossReferences
                 select cr;

        //to update the CRMapping in SelectedRatings
        foreach (SelectedRating sr in q1)
        {
            int id;
            id = 0;
            foreach (CrossReference cr in q2)
            {
                if  ((sr.PositionLetter  ==  cr.PositionLetter)  &  (sr.SelectedRatingCode  ==
cr.UniqueSelectedRating))
                {
                    id = cr.entry_pk;
                }
            }
            sr.CrMapping = id;
        }

        //get variables from overview page
        string quarter = (String)Session["Quarter"];
        string year = (String)Session["Year"];
        Boolean BSPL_required = (Boolean)Session["BSPL_required"];
        Boolean OBJT_required = (Boolean)Session["OBJT_required"];
        Boolean OBSQ_required = (Boolean)Session["OBSQ_required"];

        //to create OBCF
        foreach (SelectedRating a in q1)
         {
            OBCF obcf = new OBCF();

            obcf.Affiliate_Code = "UK";
            obcf.Record_Type = "OBCF";
            obcf.Source_System_Id = "MANUAL";
            obcf.Operation = "I";
            obcf.Operation_Date = DateTime.Now.ToString("yyyymmdd hhmmss");
            obcf.Contact_ID = a.ConIntegrationID;
            obcf.Parent_Objective_Name = quarter + " " + year + " " + a.Position +
                " BCF " + a.CrossReference.ObjectivesMapping.ObjectiveParent;
            obcf.My_Selected_Rating = a.CrossReference.ObjectivesMapping.Objective;
            obcf.My_Call_Frequency = a.CrossReference.CallFrequency;
            obcf.Product_Id = a.CrossReference.ObjectivesMapping.Product.Trim();
            obcf.Indication = a.CrossReference.ObjectivesMapping.Indication.Trim();

            db.OBCFs.InsertOnSubmit(obcf);
         }
        db.SubmitChanges();

        //distinct values of parent objt from obsq and obcf
        List<string> q3 = ((from obcf in db.OBCFs
                            select obcf.Parent_Objective_Name).Union(
                            from obsq in db.OBSQs
                            select obsq.ParentObjectiveName)).Distinct().ToList();
```

```
        //distinct values of just obcf
        List<string> q4 = (from obcf in db.OBCFs
                           select obcf.Parent_Objective_Name
                           ).Distinct().ToList();


        //to create OBJT if selected to do so on overview page
        //different query needed depending on whether OBSQ is included
        var queryNeeded = q4;
        if (OBSQ_required)
        {
            queryNeeded = q3;
        }

        if (OBJT_required)
        {
            foreach (string parent_objt in queryNeeded)
            {
                //needed to work out whether the parent objt is for sales quota as different
values req
                Boolean ifSQ = false;
                string isSQ = parent_objt.ToString().Substring(parent_objt.Length - 2, 2);

                if (isSQ == "SQ")
                {
                    ifSQ = true;
                }
                else
                {
                    ifSQ = false;
                }

                //work out the position from the parent_objt
                string position = (parent_objt.ToString()).Substring(8, 11);

                OBJT objt = new OBJT();

                objt.Affiliate_Code = "UK";
                objt.Record_Type = "OBJT";
                objt.Source_System_ID = "MANUAL";
                objt.Operation = "I";
                objt.Operation_Date = DateTime.Now.ToString("yyyymmdd hhmmss");
                objt.Name = parent_objt.ToString();

                //the objective is for sales quota
                if (ifSQ)
                {
                    objt.Type = "Sales Quota";
                    objt.Description = quarter + " Sales Quota";
                }
                //objective is for call frequency
                else
                {
                    objt.Type = "Brand Call Frequency";
                    objt.Description = quarter + " Brand Call Frequency";
                }
                //work out start & end date
                switch (quarter)
                {
                    case "Q1":
                        objt.Start_Date = year + "0101 000000";
                        objt.End_Date = year + "0331 235959";
                        objt.LLY_Local_Start_Date = year + "0101 000000";
                        objt.LLY_Local_End_Date = year + "0331 235959";
                        break;
                    case "Q2":
                        objt.Start_Date = year + "0401 000000";
                        objt.End_Date = year + "0630 235959";
                        objt.LLY_Local_Start_Date = year + "0401 000000";
                        objt.LLY_Local_End_Date = year + "0630 235959";
                        break;
                    case "Q3":
```

```
                    objt.Start_Date = year + "0701 000000";
                    objt.End_Date = year + "0930 235959";
                    objt.LLY_Local_Start_Date = year + "0701 000000";
                    objt.LLY_Local_End_Date = year + "0930 235959";
                    break;
                case "Q4":
                    objt.Start_Date = year + "1001 000000";
                    objt.End_Date = year + "1231 235959";
                    objt.LLY_Local_Start_Date = year + "1001 000000";
                    objt.LLY_Local_End_Date = year + "1231 235959";
                    break;
                    //no default required as it can only be a value from drop-down box
            }
            objt.Business_Plan_Name = quarter + " " + year + "-Territory " + position;
            objt.Status = "Planned";
            objt.Locked_Flag = "Y";
            objt.Primary_Position_Flag = "Y";
            objt.Position_Name = position;

            //to work out position division
            string positionLetter = position.Substring(10, 1);
            switch (positionLetter)
            {
                case "B":
                    objt.Position_Division = "UK-LPG-BP";
                    break;
                case "N":
                    objt.Position_Division = "UK-LPG-MOOD";
                    break;
                case "P":
                    objt.Position_Division = "UK-LPG-SCHIZ";
                    break;
                case "R":
                    objt.Position_Division = "UK-LPG-RSP";
                    break;
                default:
                    //as division is required make sure there is something if no match
                    objt.Position_Division = "UNKNOWN";
                    break;
            }
            objt.Report_Flag = "Y";

            db.OBJTs.InsertOnSubmit(objt);
        }
    }

    db.SubmitChanges();

    //select all distinct business plan names from OBJT
    List<string> q5 = (from o in db.OBJTs
                       select o.Business_Plan_Name
                       ).Distinct().ToList();


    //to create BSPL if selected to do so on overview page
    if (BSPL_required)
    {
        foreach (string bPlan in q5)
        {
            BSPL bspl = new BSPL();

            //work out position
            string  position  =  (bPlan.ToString()).Substring((bPlan.ToString()).Length  -
11, 11);

            bspl.AffiliateCode = "UK";
            bspl.RecordType = "BSPL";
            bspl.SourceSystemId = "MANUAL";
            bspl.Name = bPlan.ToString();
            bspl.Type = "Territory";
            bspl.Description = bPlan.ToString() + " Business Plan";
```

```
                switch (quarter)
                {
                    case "Q1":
                        bspl.StartDate = year + "0101 000000";
                        bspl.EndDate = year + "0331 235959";
                        bspl.LLY_LocalStartDate = year + "0101 000000";
                        bspl.LLYLocalEndDate = year + "0331 235959";
                        break;
                    case "Q2":
                        bspl.StartDate = year + "0401 000000";
                        bspl.EndDate = year + "0630 235959";
                        bspl.LLY_LocalStartDate = year + "0401 000000";
                        bspl.LLYLocalEndDate = year + "0630 235959";
                        break;
                    case "Q3":
                        bspl.StartDate = year + "0701 000000";
                        bspl.EndDate = year + "0930 235959";
                        bspl.LLY_LocalStartDate = year + "0701 000000";
                        bspl.LLYLocalEndDate = year + "0930 235959";
                        break;
                    case "Q4":
                        bspl.StartDate = year + "1001 000000";
                        bspl.EndDate = year + "1231 235959";
                        bspl.LLY_LocalStartDate = year + "1001 000000";
                        bspl.LLYLocalEndDate = year + "1231 235959";
                        break;
                    //no default required as it can only be a value from drop-down box
                }

                bspl.LockedFlag = "Y";
                bspl.PrimaryPositionFlag = "Y";
                bspl.PositionName = position;

                string positionLetter = position.Substring(10, 1);
                switch (positionLetter)
                {
                    case "B":
                        bspl.PositionDivision = "UK-LPG-BP";
                        break;
                    case "N":
                        bspl.PositionDivision = "UK-LPG-MOOD";
                        break;
                    case "P":
                        bspl.PositionDivision = "UK-LPG-SCHIZ";
                        break;
                    case "R":
                        bspl.PositionDivision = "UK-LPG-RSP";
                        break;
                    default:
                        //as division is required make sure there is something if no match
                        bspl.PositionDivision = "UNKNOWN";
                        break;
                }

                bspl.Status = "Planned";

                db.BSPLs.InsertOnSubmit(bspl);
            }
        }

            db.SubmitChanges();

            Response.Redirect("Complete_data.aspx");
    }
}
```

Appendix F: Ethics Checklist

UNIVERSITY OF BATH

Department of Computer Science

13-POINT ETHICS CHECK LIST

This document describes the 13 issues that need to be considered carefully before students or staff involve other people ("participants") for the collection of information as part of their project or research.

1. *Have you prepared a briefing script for volunteers?*
   You must explain to people what they will be required to do, the kind of data you will be collecting from them and how it will be used.
   All participants will be provided with information on what they will be required to do, the data that will be collected and how this will be used in advance for each event (Interviews, observations, participatory design and user evaluations).

2. *Will the participants be using any non-standard hardware?*
   Participants should not be exposed to any risks associated with the use of non-standard equipment: anything other than pen and paper or typical interaction with PCs on desks is considered non-standard.
   No

3. *Is there any intentional deception of the participants?*
   Withholding information or misleading participants is unacceptable if participants are likely to object or show unease when debriefed.
   No

4. *How will participants voluntarily give consent?*
   If the results of the evaluation are likely to be used beyond the term of the project (for example, the software is to be deployed, or the data is to be published), then signed consent is necessary. A separate consent form should be signed by each participant.
   Each participant will sign to state that they have read and understood how their data will be collected, used and stored. All names will be stated with initials only for reference and kept anonymously.

5. *Will the participants be exposed to any risks greater than those encountered in their normal work life?*
   Investigators have a responsibility to protect participants from physical and mental harm during the investigation. The risk of harm must be no greater than in ordinary life.
   No

6. *Are you offering any incentive to the participants?*

The payment of participants must not be used to induce them to risk harm beyond that which they risk without payment in their normal lifestyle.
No

7. Are any of your participants under the age of 16?
Parental consent is required for participants under the age of 16.
No

8. Do any of your participants have an impairment that will limit their understanding or communication?
Additional consent is required for participants with impairments.
No

9. Are you in a position of authority or influence over any of your participants?
A position of authority or influence over any participant must not be allowed to pressurise participants to take part in, or remain in, any experiment.
No

10. Will the participants be informed that they could withdraw at any time?
All participants have the right to withdraw at any time during the investigation. They should be told this in the introductory script.
Yes, this is written in the initial briefing email

11. Will the participants be informed of your contact details?
All participants must be able to contact the investigator after the investigation. They should be given the details of the Unit Lecturer or Supervisor as part of the debriefing.
Yes all participants are able to contact my supervisor or myself at any time throughout the project.

12. Will participants be de-briefed?
The student must provide the participants with sufficient information in the debriefing to enable them to understand the nature of the investigation.
Yes, all participants will be informed of what the next steps will be and how I plan to use the data I have collected. Here they will also have the opportunity to ask any other questions.

13. Will the data collected from the participants be stored in an anonymous form?
All participant data (hard copy and soft copy) should be stored securely, and in anonymous form.
As stated in point 4 names will be anonymous. No data will be passed on and will be used for relevant purpose only.

NAME: Samantha Cooper

SUPERVISOR (*IF APPLICABLE):* Hilary Johnson

SECOND READER (IF APPLICABLE): _____

PROJECT TITLE: Examining the effect of navigational redesign on end user experiences

DATE: _____